EATON | Cutler-Hammer

SV9000 AF Drives — Motor Pump Enhanced Protection Application

Application Manual

June 2004
Supersedes February 2001

Updates

Update Note: ①
- Page 2 —
- Figure 3-1 —
  - DIA3 (par. 2.2 = 10) *becomes* DIA2 (par. 11.1 = 10)

Update Note: ②
- Page 17—
- Addition to Code 12.1 Description —
  - 23 = Hot Motor Winding Detection
  - 24 = Hot Motor Bearing Detection
  - 25 = Seal Leak Detection
  - 26 = High Vibration Detection
  - 27 = Warn Flash

Update Note: ③
- Page 17 —
- Addition to Code 12.3 Description —
  - 27 = Warn Flash

Motor Pump Enhanced Protection Application

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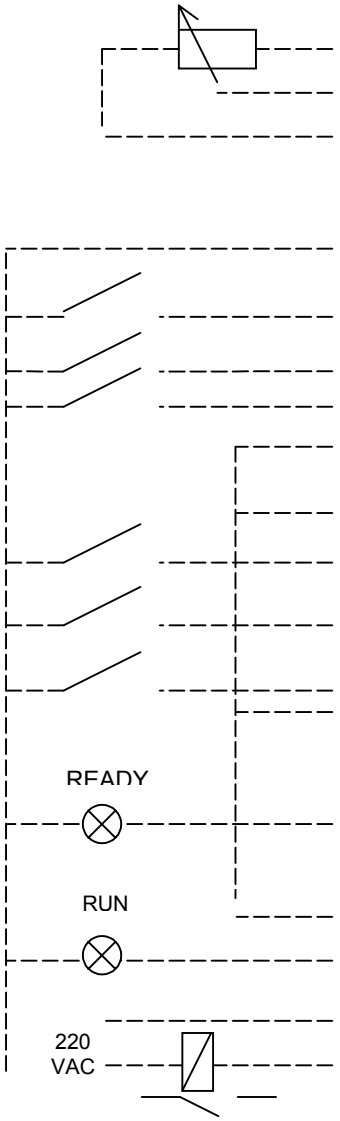
1 General

The Motor Pump Enhanced Protection application is a modified version of the normal Multi-Purpose application. It has parameters for torque control and for Fieldbus communication. The following fieldbuses are supported: Interbus, Modbus, LonWorks, CAN-bus (SDS, DeviceNet).

The frequency reference, the analog and digital outputs have extra alternatives in their control parameters, however, the source of the free analog input can not be selected from the I/O Expander as in the Multi-Purpose II application. Lastly, this application allows for up to four (4) additional custom inputs, faults, and fault indicators (when an additional I/O board is installed).

2 Control I/O



Terminal		Signal	Description
1	$+10V_{ref}$	Reference output	Voltage for potentiometer, etc.
2	$V_{in}+$	Analog input, voltage (programmable)	Frequency reference range 0—10 V DC
3	GND	I/O Ground	Ground for reference and controls
4	$I_{in}+$	Analog input, current (programmable)	Default setting: not used, range 0—20 mA
5	$I_{in}-$		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1 A
7	GND	I/O ground	Ground for reference and controls
8	DIA 1	Start forward	Contact closed = start forward
9	DIA 2	Programmable Input	Contact closed = Enable 11.1.3
10	DIA 3	Fault reset	Contact open = no action Contact closed = fault reset
11	CMA	Common for DIA 1—DIA 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see #6)
13	GND	I/O ground	Ground for reference and controls
14	DIB4	Jog speed select (programmable)	Contact open = no action Contact closed = jogging speed
15	DIB5	Programmable Input	Default = Not Used
16	DIB6	Acceleration/deceleration time select (programmable)	Contact open = par. 1.3, 1.4 in use Contact closed = par. 4.3, 4.4 in use
17	CMB	Common for DIB4—DIB6	Connect to GND or +24V
18	$I_{out}+$	Output frequency Analog output	Programmable, (par. 3.1) Range 0—20 mA/R_L, max. 500Ω
19	$I_{out}-$		
20	DO1	Digital output READY	Programmable, (par. 12.1) Open collector, I≤50mA, U≤48 VDC
21	RO1	Relay output 1 RUN	Programmable, (par. 12.2)
22	RO1		
23	RO1		
24	RO2	Relay output 2	Programmable, (par. 12.3) Default = Not used
25	RO2		
26	RO2		

Figure 2-1 Default I/O configuration and connection example of the Motor Pump Enhanced Protection Application

3 Control Signal Logic

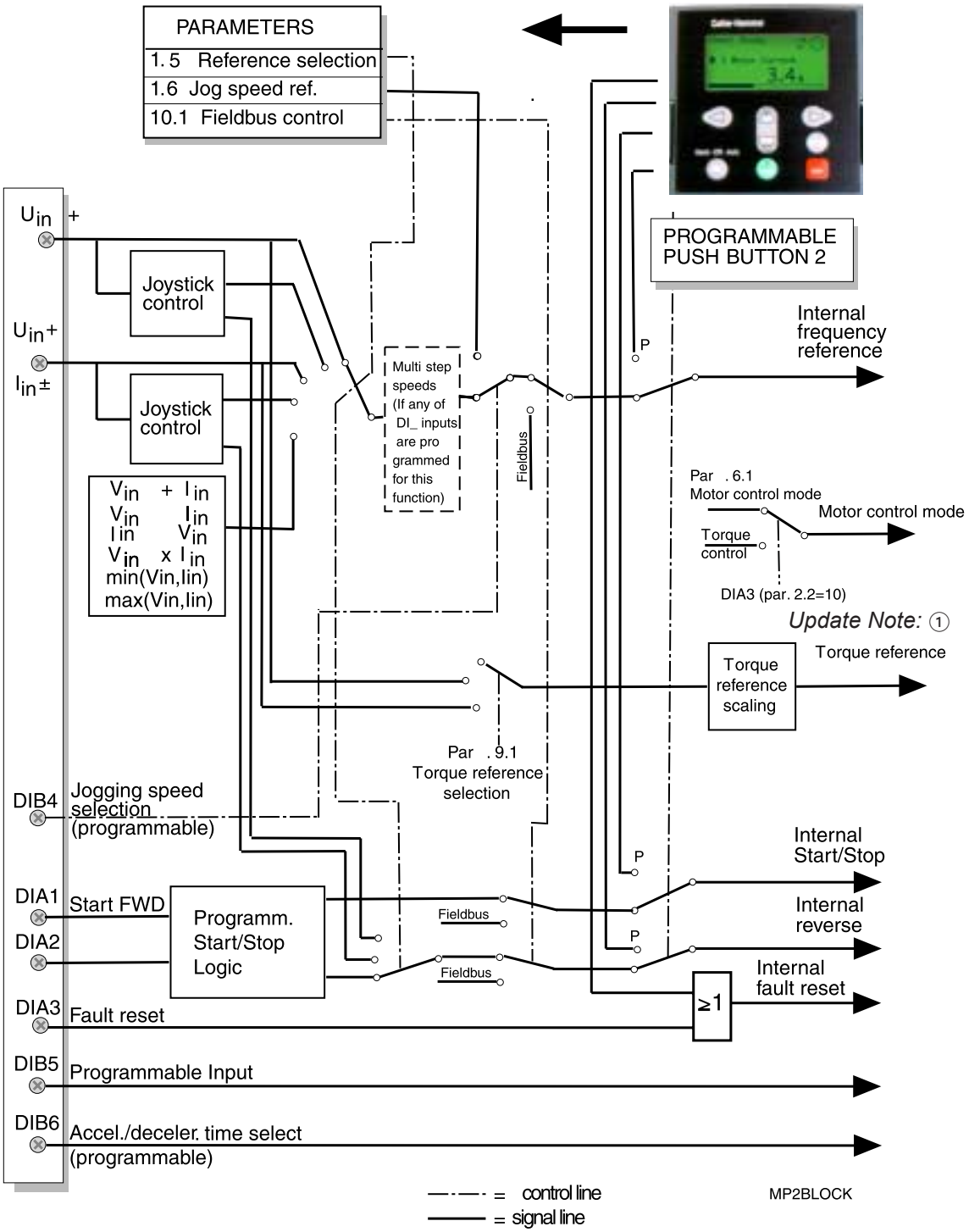


Figure 3-1: Control Signal Logic of the Motor Pump Enhanced Protection Application Switch positions correspond to factory settings.

4 Parameter Group 0

Number	Parameter	Range	Step	Default	Customer	Description
0.1	Application selection	0-7	1	0		0 = Motor Pump Enhanced Protection (loaded special application) 1 = Basic Application 2 = Standard Application 3 = Local/Remote 4 = Multi-step Speed Application 5 = PI-control Application 6 = Multi-purpose Control Application 7 = Pump and Fan control Application
0.2	Parameter Loading	0-5	1	0		0 = Loading ready / Select loading 1 = Load default setting 2 = Read up parameters to user's set 3 = Load down user's set parameters 4 = Read parameters up to the panel (possible only with the graphical panel) 5 = Load down parameters from the panel (possible only with graphical panel)
0.3	Language Selection			0		0 = English

4.1 Application Selection

With this parameter the active application can be selected. If the device has been ordered from the factory equipped with the Multipurpose II application this has been loaded in the unit as application 0. The application has also been set active at the factory. However, check that the value of the parameter 0.1 is zero when you want to use Motor Pump EP.

If the application is loaded later it has to be activated after loading by setting the value of parameter 0.1 to zero.

4.2 Parameter Loading

See User's Manual chapter 11.

4.3 Language

With this parameter, the language of the graphical panel can be selected.

5 Basic Parameters, Group 1

5.1 Parameter Table

Code	Parameter	Range	Step	Default	Custom	Description	Page
1.1	Minimum frequency	0—120/500 Hz	1 Hz	0 Hz			5
1.2	Maximum frequency	0—120/500 Hz	1 Hz	50 Hz	*		5
1.3	Acceleration time 1	0.1—3000 s	0.1 s	3 s		Time from f_{min} (1. 1) to f_{max} (1. 2)	5
1.4	Deceleration time 1	0.1—3000	0.1 s	3 s		Time from f_{max} (1. 2) to f_{min} (1. 1)	5
1.5	Reference selection	0—13				0 = V_{in} / 3 = V_{in} - I_{in} 1 = I_{in} / 4 = I_{in} - V_{in} 2 = V_{in} + I_{in} / 5 = V_{in} * I_{in} 6 = V_{in} joystick control 7 = I_{in} joystick control 8 = Signal from internal motor pot. 9 = Signal from internal motor pot. reset if SV9000 unit is stopped 10 = Signal from internal motor pot. (stored in memory over utility break) 11 = Min (V_{in}, I_{in}) 12 = Max (V_{in}, I_{in}) 13 = Panel reference r1	5
1.6	Jog speed reference	f_{min} —f_{max}	0.1 Hz	5 Hz			6
1.7	Current limit	0.1—2.5 x I_{nSV9}	0.1 A	1.5 x I_{nSV9}		Output current limit [A] of the unit	6
1.8	V/Hz ratio selection	0—2	1	0		0 = Linear 1 = Squared 2 = Programmable V/Hz ratio	7
1.9	V/Hz optimization	0—1	1	0		0 = None 1 = Automatic torque boost	8
1.10	Nominal voltage of the motor	180—690	1 V	230 V 380 V 480 V 575 V		Voltage code 2 Voltage code 4 Voltage code 5 Voltage code 6	8
1.11	Nominal frequency of the motor	30—500 Hz	1 Hz	60 Hz		f_n on the rating plate of the motor	8
1.12	Nominal speed of the motor	1—20000 rpm	1 rpm	1440 rpm		n_n on the rating plate of the motor	8
1.13	Nominal current of the motor	2.5 x I_{nSV9}	0.1 A	I_{nSV9}		I_n on the rating plate of the motor	8
1.14	Supply voltage	180—250 380—440 380—500 525—690		230 V 380 V 480 V 575 V		Voltage code 2 Voltage code 4 Voltage code 5 Voltage code 6	8
1.15	Parameter conceal	0—1	1	0		Visibility of the parameters: 0 = All parameter groups visible 1 = Only group 1 is visible	8
1.16	Parameter value lock	0—1	1	0		Disables parameter changes: 0 = Changes enabled 1 = Changes disabled	8

***** If 1.2 >motor synchr. speed, check suitability for motor and drive system.

Note! = Parameter value can be changed only when the frequency converter is stopped.

Table 5-1 Group 1 Basic Parameters.

5.2 Description of Group 1 Parameters

1.1 Minimum frequency

1.2 Maximum frequency

Defines frequency limits of the frequency converter. The default maximum value for parameters 1.1 and 1.2 is 120 Hz. By setting 1.2 = 120 Hz when the device is stopped (RUN indicator not lit) the maximum value of parameters 1.1 and 1.2 is changed to 500 Hz. At the same time the panel reference resolution is changed from 0.01 Hz to 0.1 Hz. Changing the maximum value from 500 Hz to 120 Hz is done by setting parameter 1.2 = 119 Hz when the device is stopped.

1.3 Acceleration time 1

1.4 Deceleration time 1

These limits correspond to the time required for the output frequency to accelerate from the set minimum frequency (par. 1.1) to the set maximum frequency (par. 1.2).

1.5 Reference selection

0 Analog voltage reference from terminals 2—3, e.g. a potentiometer

1 Analog current reference from terminals 4—5, e.g. a transducer.

2 Reference is formed by adding the values of the analog inputs

3 Reference is formed by subtracting the voltage input (V_{in}) value from the current input (I_{in}) value

4 Reference is formed by subtracting the current input (I_{in}) value from the voltage input (V_{in}) value

5 Reference is the formed by multiplying the values of the analog inputs

6 Joystick control from the voltage input (V_{in}).

Signal Range	Max Reverse Speed	Direction Change	Max Forward Speed
0—10 V	0 V	5 V	+10 V
Custom	Par. 2.2 x 10V	In the middle of custom range	Par. 2.3 x 10 V
-10 V—+10 V	-10 V	0 V	+10 V

Warning! Use only the -10V—+10 V signal range. If a custom or 0—10 V signal range is used, the drive starts to run at the maximum reverse speed if the reference signal is lost.

7 Joystick control from the current input (I_{in}).

Signal Range	Max Reverse Speed	Direction Change	Max Forward Speed
0—20 mA	0 mA	10 mA	20 mA
Custom	Par. 2.8 x 20 mA	In the middle of custom range	Par. 2.9 x 20 mA
4—20 mA	4 mA	12 mA	20 mA

Warning! Use only 4—20 mA signal range. If custom or 0—20 mA signal range is used, the drive runs at maximum reverse speed if the control signal is lost. Set the reference fault (par. 7.2) active when the 4—20 mA range is used, then the drive will stop to the reference fault if the reference signal is lost.

Note! When joystick control is used, the direction control is generated from the joystick reference signal. See figure 5.2-1.

Analog input scaling, parameters 2.11—2.14 are not used when joystick control is used.

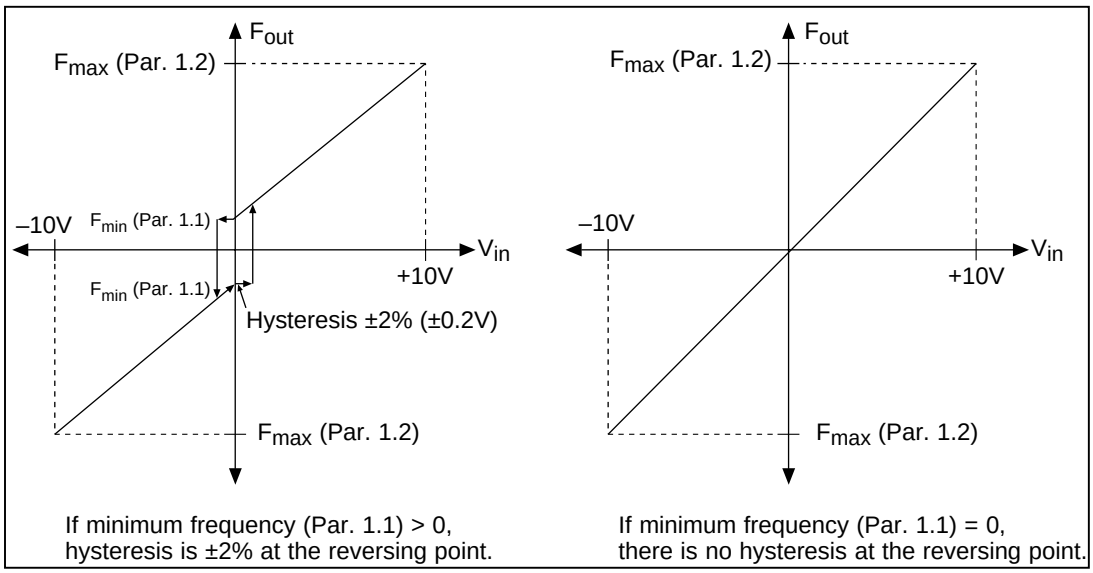


Figure 5.2-1: Joystick Control V_{in} Signal -10 V—+10 V

8 Reference value is changed with digital input signals DIA4 and DIA5.
- switch in DIA3 closed = frequency reference increases
- switch in DIA4 closed = frequency reference decreases
Speed of reference change can be set with parameter 2.15.

9 Same as setting 8 but the reference value is set to the minimum frequency (par. 1.1) each time the frequency converter is stopped.

10 Same as setting 8 but the reference is stored to the memory over utility break. When the value of the parameter 1.5 is set to 8, 9 or 10, the value of the parameters 11.4 and 11.5 is automatically set to 11.

11 The smaller of signals V_{in} and I_{in} is the frequency reference

12 The greater of signals V_{in} and I_{in} is the frequency reference

13 Panel reference r1 is the frequency reference

1.6 Jogging speed reference

Parameter value defines the jogging speed selected with the digital input.

1.7 Current limit

This parameter determines the maximum motor current from the frequency converter. To avoid motor overload, set this parameter according to the rated current of the motor.

1.8 V/Hz ratio selection

Linear:

0 The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point (par. 6.3) where the nominal voltage is also supplied to the motor. See figure 5.2-2. Linear V/Hz ratio should be used in constant torque applications.

This default setting should be used if there is no special need for another setting.

Squared:

1 The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point (par. 6.3) where the nominal voltage is also supplied to the motor. See figure 5.2-2. The motor runs undermagnetized below the field weakening point and produces less torque and electromechanical noise. Squared V/Hz ratio can be used in applications where torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

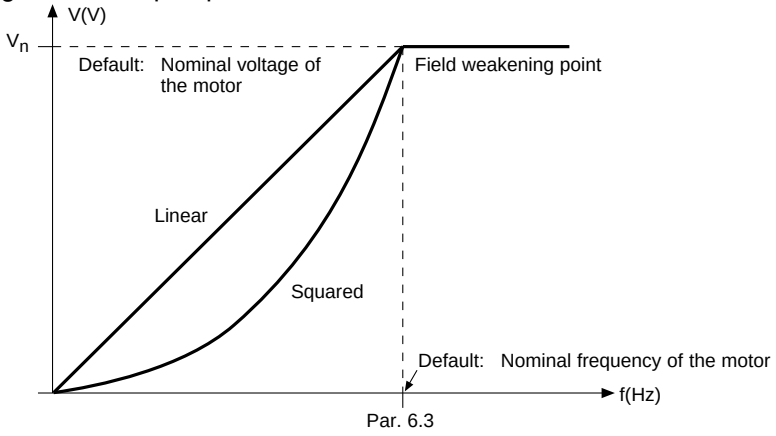


Figure 5.2-2: Linear and Squared V/Hz Curves

Programming: The V/Hz curve can be programmed with three different points V/Hz curve:

2 The parameters for programming are explained in chapter 6.2.5. Programmable V/Hz curve can be used if the other settings do not satisfy the needs of the application. See figure 5.2-3.

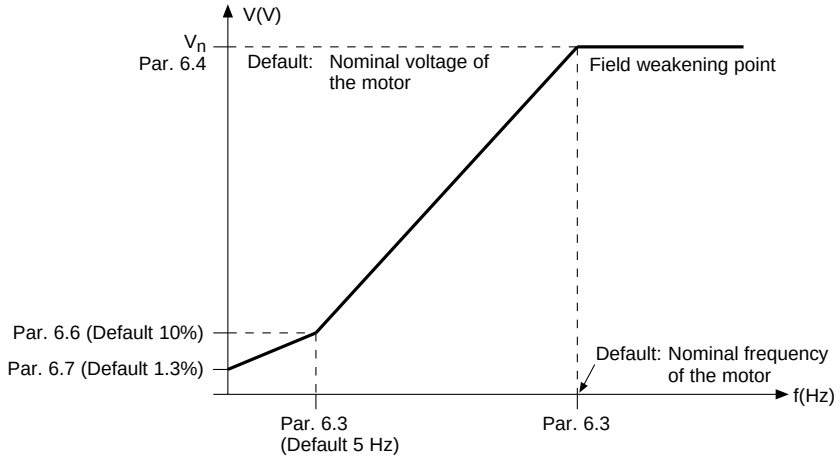


Figure 5.2-3: Programmable V/Hz Curve

1.9 V/Hz optimization

Automatic: The voltage to the motor changes automatically which makes the torque motor produce sufficient torque to start and run at low frequencies. The boost voltage increase depends on the motor type and power.

Automatic torque boost can be used in applications where starting torque due to starting friction is high, e.g. in conveyors.

Note! In high torque / low speed applications, it is likely the motor will overheat. If the motor has to run a prolonged time under these conditions, special attention must be paid to cooling the motor. Use external cooling for the motor if the temperature tends to rise too high.

1.10 Nominal voltage of the motor

Find this value V_n on the rating plate of the motor.
This parameter sets the voltage at the field weakening point, parameter 6.4, to 100% x V_{nmotor}.

1.11 Nominal frequency of the motor

Find this value f_n on the rating plate of the motor.
This parameter sets the field weakening point, parameter 6.3, to the same value.

1.12 Nominal speed of the motor

Find this value n_n on the rating plate of the motor.

1.13 Nominal current of the motor

Find this value I_n on the rating plate of the motor.

1.14 Supply voltage

Set the parameter value according to the nominal voltage of the supply.
Values are predefined for voltage codes 2, 4, 5 and 6. See table 5-1.

1.15 Parameter conceal

Defines which parameter groups are available:

0 = all parameter groups are visible
1 = only group 1 is visible

1.16 Parameter value lock

Allows parameter value changes:

0 = parameter value changes enabled
1 = parameter value changes disabled

6 Special parameters, Groups 2—10

6.1 Parameter tables

Group 2, Input signal parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
2.1	V_{in} signal range	0—2	1	0		0 = 0—10 V 1 = Custom setting range 2 = -10—+10 V (can be used only with Joystick control)	19
2.2	V_{in} custom setting min.	0—100%	0.01%	0.00%			19
2.3	V_{in} custom setting max.	0—100%	0.01%	100.00%			19
2.4	V_{in} signal inversion	0—1	1	0		0 = Not inverted 1 = Inverted	19
2.5	V_{in} signal filter time	0 —10s	0.01s	0.1s		0 = No filtering	19
2.6	I_{in} signal range	0—2	1	0		0 = 0—20 mA 1 = 4—20 mA 2 = Custom setting range	19
2.7	I_{in} custom setting min.	0—100%	0.01%	0.00%			20
2.8	I_{in} custom setting max.	0—100%	0.01%	100.00%			20
2.9	I_{in} signal inversion	0—1	1	0		0 = Not inverted	20
2.10	I_{in} signal filter time	0 —10s	0.01s	0.1s		0 = No filtering	20
2.11	V_{in} minimum scaling	-320.00% —+320.00%	0%	0.01		0% = no minimum scaling	20
2.12	V_{in} maximum scaling	-320.00% —+320,00 %	100%	0.01		100% = no maximum scaling	20
2.13	I_{in} minimum scaling	-320.00% —+320.00%	0%	0.01		0% = no minimum scaling	20
2.14	I_{in} maximum scaling	-320.00% —+320.00%	100%	0.01		100% = no maximum scaling	20
2.15	Free analog input, signal selection	0—4	1	0		0 = Not use 1 = V_{in} (analog voltage input) 2 = I_{in} (analog current input) 3 = A_{in1} (option board) 4 = A_{in2} (option board)	21
2.16	Free analog input, function	0—4	1	0		0 = No function 1 = Reduces current limit (par. 1.7) 2 = Reduces DC-braking current 3 = Reduces acc. and decel. times 4 = Reduces torque supervis. limit	21
2.17	Motorized potentiometer ramp time	0.1—2000.0 Hz/s	0.1 Hz/s	10.0 Hz/s			23
2.18	Option board A_{in1} signal inversion	0—1	1	0		0 = Not inverted 1 = Inverted	23
2.19	Option board A_{in1} signal filter time	0—10s	0.01s	0.1s		0 = No filtering	23
2.20	Option board A_{in2} signal range	0—2	1	0		0 = 0—20 mA 1 = 4—20 mA 2 = 0—10 V	23
2.21	Option board A_{in2} signal inversion	0—1	1	0		0 = Not inverted 1 = Inverted	23
2.22	Option board A_{in2} signal filter time	0 —10s	0.01s	0.1s		0 = No filtering	23

Group 3, Output and supervision parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
3.1	Analog output function	0—11	1	1		0 = Not used Scale 100% 1 = O/P frequency (0—f_{max}) 2 = Motor speed (0—max. speed) 3 = O/P current (0—2.0 x I_{nSV9}) 4 = Motor torque (0—2 x T_{nSV9}) 5 = Motor power (0—2 x P_{nSV9}) 6 = Motor voltage (0—100% x U_{nM}) 7 = DC-link volt. (0—1000 V) 8 = Input signal V_{in} 9 = Input signal I_{in} 10 =Reference frequency 11 =Reference torque	24
3.2	Analog outp. filter time	0.01—10 s	0.01	1.00			24
3.3	Analog outp. inversion	0—1	1	0		0 = Not inverted 1 = Inverted	24
3.4	Analog output minimum	0—1	1	0		0 = 0 mA 1 = 4 mA	25
3.5	Analog output scale	10—1000%	1%	100%			25
3.6	Output freq. limit 1 supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	25
3.7	Output freq. limit 1 supervision value	0—f_{max} (par. 1. 2)	0.1 Hz	0 Hz			25
3.8	Output freq. limit 2 supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	25
3.9	Output freq. limit 2 supervision value	0—f_{max} (par.1. 2)	0.1 Hz	0 Hz			25
3.10	Torque limit supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	26
3.11	Torque limit supervision value	0—200% xT_{nSV9}	1%	100%			26
3.12	Reference limit supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	26
3.13	Reference limit supervision value	0—f_{max} (par. 1. 2)	0.1 Hz	0 Hz			26
3.14	Extern. brake Off-delay	0—100.0 s	0.1 s	0.5 s			26
3.15	Extern. brake On-delay	0—100.0 s	0.1 s	1.5 s			26
3.16	Frequency converter temperature limit supervision function	0—2	1	0		0 = No 1 = Low limit 2 = High limit	27
3.17	Frequency converter temperature limit value	-10—+75°C	1°C	+40°C			27
3.18	I/O-expander board (opt.) analog output content	0—9	1	3		See parameter 3. 1	27
3.19	I/O-expander board (opt.) analog output filter time	0.01—10 s	0.01	1.00		See parameter 3. 2	27
3.20	I/O-expander board (opt.) analog output inversion	0—1	1	0		See parameter 3. 3	27
3.21	I/O-expander board (opt.) analog output minimum	0—1	1	0		See parameter 3. 4	27
3.22	I/O-expander board (opt.) analog output scale	10—1000%	1	100%		See parameter 3. 5	27
3.23	Analog output offset (basic control board)	-100% — 100.0%	1	100%			27
3.24	I/O-expander board (opt.) analog output offset	-100% — +100.0%	1	100%			27

Group 4, Drive Control Parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
4.1	Acc./Dec. ramp 1 shape	0—10 s	0.1 s	0		0 = Linear >0 = S-curve acc./dec. time	28
4.2	Acc./Dec. ramp 2 shape	0—10 s	0.1 s	0		0 = Linear >0 = S-curve acc./dec. time	28
4.3	Acceleration time 2	0.1—3000 s	0.1 s	10 s			28
4.4	Deceleration time 2	0.1—3000 s	0.1 s	10 s			28
4.5	Brake chopper	0—1	1	0		0 = Brake chopper not in use 1 = Brake chopper in use 2 = External brake chopper	28
4.6	Start function	0—1	1	0		0 = Ramp 1 = Flying start	29
4.7	Stop function	0—1	1	0		0 = Coasting 1 = Ramp	29
4.8	DC-braking current	0.15—1.5 x I_{nSV9} (A)	0.1 A	0.5 x I_{nSV9}			29
4.9	DC-braking time at Stop	0—250.0 s	0.1 s	0 s		0 = DC-brake is off at Stop	29
4.10	Execute freq. of DC-brake during ramp Stop	0.1—10 Hz	0.1 Hz	1.5 Hz			30
4.11	DC-brake time at Start	0.0—25.0 s	0.1 s	0 s		0 = DC-brake is off at Start	30
4.12	Multi-step speed reference 1	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	10 Hz			31
4.13	Multi-step speed reference 2	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	15 Hz			31
4.14	Multi-step speed reference 3	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	20 Hz			31
4.15	Multi-step speed reference 4	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	25 Hz			31
4.16	Multi-step speed reference 5	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	30 Hz			31
4.17	Multi-step speed reference 6	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	40 Hz			31
4.18	Multi-step speed reference 7	f_{min} —f_{max} (1. 1) (1. 2)	0.1 Hz	50 Hz			31

Group 5, Prohibit frequency parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
5.1	Prohibit frequency range 1 low limit	0—f_{max} (1. 2)	0.1 Hz	0 Hz			32
5.2	Prohibit frequency range 1 high limit	0—f_{max} (1. 2)	0.1 Hz	0 Hz		0 = Prohibit range 1 is off	32
5.3	Prohibit frequency range 2 low limit	0—f_{max} (1. 2)	0.1 Hz	0 Hz			32
5.4	Prohibit frequency range 2 high limit	0—f_{max} (1. 2)	0.1 Hz	0 Hz		0 = Prohibit range 2 is off	32
5.5	Prohibit frequency range 3 low limit	0—f_{max} (1. 2)	0.1 Hz	0 Hz			32
5.6	Prohibit frequency range 3 high limit	0—f_{max} (1. 2)	0.1 Hz	0 Hz		0 = Prohibit range 3 is off	32

Group 6, Motor Control Parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
6.1	Motor control mode	0—2	1	0		0 = Frequency control 1 = Speed control (open loop) 2 = Torque control (open loop)	32
6.2	Switching frequency	1—16 kHz	0.1 kHz	10/3.6 kHz		Dependant on HP	32
6.3	Field weakening point	30—500 Hz	1 Hz	Param. 1. 11			32
6.4	Voltage at field weakening point	15 —200% x U_{nmot}	1%	100%			32
6.5	V/HZ-curve mid-point frequency	0—500 Hz	0.1 Hz	0 Hz			33
6.6	V/HZ-curve mid-point voltage	0—100% x U_{nmot}	0.01 %	0 %			33
6.7	Output voltage at zero frequency	0—100% x U_{nmot}	0.01 %	0 %			33
6.8	Overvoltage controller	0—1	1	1		0 = Controller is not operating 1 = Controller is operating	33
6.9	Undervoltage controller	0—1	1	1		0 = Controller is not operating 1 = Controller is operating	33

Group 7, Protections

Code	Parameter	Range	Step	Default	Custom	Description	Page
7.1	Response to reference fault	0—2	1	0		0 = No action 1 = Warning 2 = Fault, stop according to par 4.7 3 = Fault, stop always by coasting	33
7.2	Response to external fault	0—2	1	2		0 = No action 1 = Warning 2 = Fault, stop according to par 4.7 3 = Fault, stop always by coasting	34
7.3	Phase supervision of the motor	0—2	2	2		0 = No action 2 = Fault	34
7.4	Earth fault protection	0—2	2	2		0 = No action 2 = Fault	34
7.5	Motor thermal protection	0—2	1	2		0 = No action 1 = Warning 2 = Fault	35
7.6	Motor thermal protection break point current	50—150% x I_{nMOTOR}	1.0 %	100.0%			35
7.7	Motor thermal protection zero frequency current	10.0—150% x I_{nMOTOR}	1.0 %	45.0%			36
7.8	Motor thermal protection time constant	0.5—300.0 minutes	0.5 min.			Default value is set according to motor nominal current	36
7.9	Motor thermal protection break point frequency	10—500 Hz	1 Hz	35 Hz			37
7.10	Stall protection	0—2	1	1		0 = No action 1 = Warning 2 = Fault	38
7.11	Stall current limit	10.0—200% x I_{nMOTOR}	1.0%	130.0%			38
7.12	Stall time	2.0—120 s	1.0 s	15.0 s			39
7.13	Maximum stall frequency	1—f_{max}	1 Hz	25 Hz			39
7.14	Underload protection	0—2	1	0		0 = No action 1 = Warning 2 = Fault	39
7.15	Underload prot., field weakening area load	20—150 % x T_{nMOTOR}	1.0%	50.0%			40
7.16	Underload protection zero frequency load	10—150% x T_{nMOTOR}	1.0%	10.0%			40
7.17	Underload time	2.0—600.0s	1.0 s	20.0s			40
7.18	Phase supervision of the supply voltage	0—2	2	2		0 = No action 2 = Fault	41
7.19	Thermistor input of I/O-Expander	0—2	1	2		0 = No action 1 = Warning 2 = Fault	41
7.20	Response to fieldbus fault	0—2	1	0		0 = Not used 1 = Warning 2 = Fault	41

Group 8, Autorestart parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
8.1	Automatic restart: number of tries	0—10	1	0		0 = not in use	42
8.2	Automatic restart: trial time	1—6000 s	1 s	30 s			42
8.3	Automatic restart: start function	0—1	1	0		0 = Ramp 1 = Flying start	42
8.4	Automatic restart of undervoltage	0—1	1	0		0 = No 1 = Yes	42
8.5	Automatic restart of overvoltage	0—1	1	0		0 = No 1 = Yes	42
8.6	Automatic restart of overcurrent	0—1	1	0		0 = No 1 = Yes	42
8.7	Automatic restart of reference fault	0—1	1	0		0 = No 1 = Yes	42
8.8	Automatic restart after over/undertemperature fault	0—1	1	0		0 = No 1 = Yes	42

Group 9, Torque Control

Code	Parameter	Range	Step	Default	Custom	Description	Page
9.1	Torque reference selection	0—2	1	0		0 = None 1 = V_{in} 2 = I_{in}	44
9.2	Torque reference scaling bias	-100% — +100%	1	0		0 = not in use	44
9.3	Torque reference scaling gain	-320% — +320%	1	100		100 = no scaling	44
9.4	TC time constant	1—1000 ms	1 ms	128 ms			44
9.5	TC min. control limit	0—10.00 Hz	0.01 Hz	3.00 Hz			44

Group 10, Fieldbus Parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
10.1	Fieldbus control select	0—1	1	0		0 = Control via I/O terminals 1 = Control via Fieldbus board	45
10.2	MODBUS Slave address	1—247	1	1			45
10.3	Baud rate	1—7	1	6		1 = 300 baud 2 = 600 baud 3 = 1200 baud 4 = 2400 baud 5 = 4800 baud 6 = 9600 baud 7 = 19200 baud	45
10.4	MB Parity type	0ó 2	1	0		0 = None 1 = Even 2 = Odd	45
10.5	Modbus time-out	0ó 3600 s	1 s	0 s		0 = No time-out	45
10.6	Profibus slave address	2ó 126	1	2			45
10.7	Profibus baud rate	1ó 10	1	10		1 = 9.6 kbaud 2 = 19.2 kbaud 3 = 93.75 kbaud 4 = 187.5 kbaud 5 = 500 kbaud 6 = 1.5 Mbaud 7 = 3 Mbaud 8 = 6 Mbaud 9 = 12 Mbaud 10 = AUTO	46
10.8	Profibus PPO Type	1ó 4	1	1		1 = PPO 1 2 = PPO 2 3 = PPO 3 4 = PPO 4	46
10.9	Profibus Process Data 1	0ó 99	1	1			46
10.10	Profibus Process Data 2	0ó 99	1	2			46
10.11	Profibus Process Data 3	0ó 99	1	3			46
10.12	Profibus Process Data 4	0ó 99	1	99			46
10.13	LonWorks Service Button	0ó 1	1	0			46

Group 11, Digital Input Parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
11.1	DIA2 function	0—15	1	0		0 = Not Used 1 = Ext. Fault, Closing Contact 2 = External Fault, Opening Contact 3 = Run Enable 4 = Acc./Dec. Time Selection 5 = Reverse 6 = Jogging Speed 7 = Fault Reset 8 = Acc./Dec. Operation Prohibit 9 = DC-Braking Command 10 = Torque Control 11 = Hot Motor Winding - Open Contact 12 = Hot Motor Bearing - Open Contact 13 = Seal Leak Detection - Closed Contact 14 = High Vibration - Closed Contact 15 = Multi-Step Speed Select 1	47
11.2	DIB4 function (terminal 14)	0—14	1	0		0 = Not used 1 = Ext. fault, closing contact 2 = External fault, opening contact 3 = Run enable 4 = Acc./dec. time selection 5 = Reverse 6 = Jogging speed 7 = Fault reset 8 = Acc./dec. operation prohibit 9 = DC-braking command 10 = Torque Reference Signal 11 = Hot Motor Winding - Open Contact 12 = Hot Motor Bearing - Open Contact 13 = Seal Leak Detection - Closed Contact 14 = High Vibration - Closed Input 15 = Multi-Step Speed Select 2	48
11.3	DIB5 function (terminal 15)	0—14	1	0		0 = Not used 1 = Ext. fault, closing contact 2 = External fault, opening contact 3 = Run enable 4 = Acc./dec. time selection 5 = Reverse 6 = Jogging speed 7 = Fault reset 8 = Acc./dec. operation prohibit 9 = DC-braking command 10 = Motorized Pot Speed Up 11 = Seal Leak Detection - Open Contact 12 = High Vibration - Open Contact 13 = Hot Motor Winding - Closed Contact 14 = Hot Motor Bearing - Closed Contact 15 = Multi-Step Speed Select 3	48
11.4	DIB6 function (terminal 16)	0—11	1	0		0 = Not used 1 = Ext. fault, closing contact 2 = External fault, opening contact 3 = Run enable 4 = Acc./dec. time selection 5 = Reverse 6 = Jogging speed 7 = Fault reset 8 = Acc./dec. operation prohibit 9 = DC-braking command 10 = Motorized Pot Speed Down 11 = Seal Leak Det. - Open Contact 12 = High Vibration - Open Contact 13 = Hot Motor Winding - Closed Contact 14 = Hot Motor Bearing - Closed Contact	48

Group 11, Digital Input Parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
11.5	DIC1 function	0—15	1	0		0 = Not used 1 = Ext. fault, closing contact 2 = External fault, opening contact 3 = Run enable 4 = Acc./dec. time selection 5 = Reverse 6 = Jogging speed 7 = Fault reset 8 = Acc./dec. operation prohibit 9 = DC-braking command 10 = Multi-Step Speed Select 1 11 = Motorized pot. speed up 12 = Hot Motor Winding - Open Contact 13 = Hot Motor Bearing - Open Contact 14 = Seal Leak Detection - Closed Contact 15 = High Vibration - Closed Contact	48
11.6	DIC2 function	0 – 15	1	0		0 = Run Enable Open 1 = Ext. fault, closing contact 2 = External fault, opening contact 3 = Run Enable, Close 4 = Acc./dec. time selection 5 = Reverse 6 = Jogging speed select 7 = Fault reset 8 = Acc./dec. operation prohibit 9 = DC-braking command 10 = Multi-Step Speed Select 2 11 = Motorized pot. speed down 12 = Hot Motor Detection - Open Contact 13 = Hot Motor Bearing - Open Contact 14 = Seal Leak Detection - Closed Contact 15 = High Vibration - Closed Contact	48
11.7	Hot Motor Winding Delay	0-600.0 s	0.1	2.0		0 = Delay not in use	49
11.8	Hot Motor Bearing Delay	0-600.0 s	0.1	2.0		0 = Delay not in use	49
11.9	Seal Leak Detection Delay	0-600.0 s	0.1	2.0		0 = Delay not in use	49
11.10	High Vibration Delay	0-600.0 s	0.1	2.0		0 = Delay not in use	49

Group 12, Digital Output Parameters

Code	Parameter	Range	Step	Default	Custom	Description	Page
12.1	Digital output function	0—22	1	2.0 1 *Update Note:* ②		0 = Not used 1 = Ready 2 = Run 3 = Fault 4 = Fault inverted 5 = SV9000 overheat warning 6 = External fault or warning 7 = Reference fault or warning 8 = Warning 9 = Reversed 10 = Jogging speed selected 11 = At speed 12 = Motor regulator activated 13 = Output freq. limit superv. 1 14 = Output freq. limit superv. 2 15 = Torque limit supervision 16 = Reference limit supervision 17 = External brake control 18 = Control from I/O terminals 19 = Frequency converter temperature limit supervision 20 = Unrequested rotation direction 21 = External brake control inverted 22 = Thermistor fault or warning	50
12.2	Relay output function	0—22	1	2		Same as below (parameter 12. 3)	50
12.3	Relay 2 output function	0—26	1	3 *Update Note:* ③		0 = Not used 1 = Ready 2 = Run 3 = Fault 4 = Fault inverted 5 = SV9000 overheat warning 6 = External fault or warning 7 = Reference fault or warning 8 = Warning 9 = Reversed 10 = Jogging speed selected 11 = At speed 12 = Motor regulator activated 13 = Output freq. limit superv. 1 14 = Output freq. limit superv. 2 15 = Torque limit supervision 16 = Reference limit supervision 17 = External brake control 18 = Control from I/O terminals 19 = Frequency converter temperature limit supervision 20 = Unrequested rotation direction 21 = External brake control inverted 22 = Thermistor fault or warning 23 = Hot Motor Winding Fault 24 = Hot Motor Bearing Fault 25 = Seal Leak Detection Fault 26 = High Vibration Fault	50
12.4	Relay 3 output function	0—26	1	0		Same as above (parameter 12. 3)	50
12.5	Relay 4 output function	0—26	1	0		Same as above (parameter 12. 3)	50
12.6	Relay 5 output function	0—26	1	0		Same as above (parameter 12. 3)	50
12.7	Digital output DO1 on delay	0—600.0 s	0.1 s	0		0 = delay not in use	51
12.8	Digital output DO1 off delay	0—600.0 s	0.1 s	0		0 = delay not in use	51
12.9	Relay output RO1 on delay	0—600.0 s	0.1 s	0		0 = delay not in use	51
12.10	Relay output RO1 off delay	0—600.0 s	0.1 s	0		0 = delay not in use	51
12.11	Relay output RO2 on delay	0—600.0 s	0.1 s	2.0		0 = delay not in use	51

12.12	Relay output RO2 off delay	0 – 600.0 s	0.1 s	0		0 = delay not in use	51
12.13	Relay output RO3 on delay	0 – 600.0 s	0.1 s	2.0		0 = delay not in use	51
12.14	Relay output RO3 off delay	0 – 600.0 s	0.1 s	0		0 = delay not in use	51
12.15	Relay output RO4 on delay	0 – 600.0 s	0.1 s	2.0		0 = delay not in use	51
12.16	Relay output RO4 off delay	0 – 600.0 s	0.1 s	0		0 = delay not in use	51
12.17	Relay output RO5 on delay	0 – 600.0 s	0.1 s	2.0		0 = delay not in use	51
12.18	Relay output RO5 off delay	0 – 600.0 s	0.1 s	0		0 = delay not in use	51

6.2 Description of Groups 2-10 Parameters

6.2.1 Group 2, Analog Input Signal Parameters

2.1 V_{in} signal range

0 = Signal range 0—+10 V

1 = Custom setting range from custom minimum (par. 2.2) to custom maximum (par. 2.3)

2 = Signal range -10—+10 V , can be used only with Joystick control

2.2- V_{in} custom setting minimum

2.3 V_{in} custom setting maximum

With these parameters, V_{in} can be set for any input signal span within 0—10 V.

Minimum setting: Set the V_{in} signal to its minimum level, select parameter 2.2, press the Enter button

*Maximum setting:*Set the V_{in} signal to its maximum level, select parameter 2.3, press the Enter button

Note! These parameters can only be set with this procedure (not with arrow up/arrow down buttons)

2.4 V_{in} signal inversion

0 = no inversion of analog V_{in} signal.

1 = inversion of analog V_{in} signal.

2.5 V_{in} signal filter time

Filters out disturbances from the incoming analog V_{in} signal. Long filtering time makes regulation response slower. See figure 6.2-1.

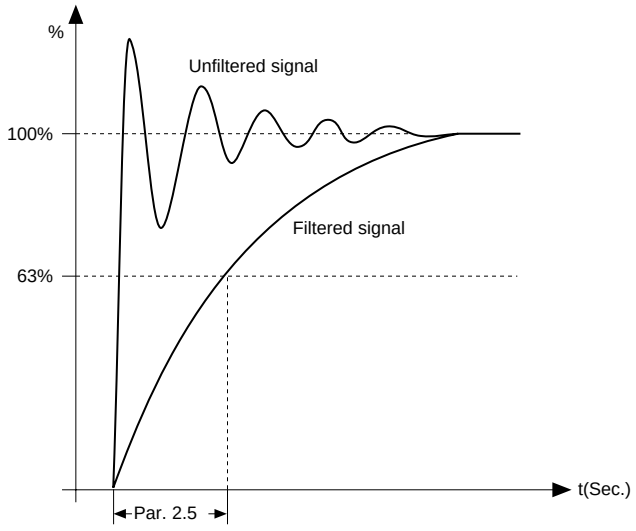


Figure 6.2-:1 V_{in} Signal Filtering

2.6 Analog input I_{in} signal range

0 = 0—20 mA

1 = 4—20 mA

2 = Custom signal span

2.7 Analog input I_{in} custom setting minimum

2.8 Analog input I_{in} custom setting maximum

With these parameters, the scaling of the input current signal (I_{in}) range can be set between 0—20 mA.

Minimum setting: Set the I_{in} signal to its minimum level, select parameter 2.7, press the Enter button.

Maximum setting: Set the I_{in} signal to its maximum level, select parameter 2.8, press the Enter button.

Note! These parameters can only be set with this procedure (not with arrow up/arrow down buttons)

2.9 Analog input I_{in} signal inversion

0 = no inversion of I_{in} input

1 = inversion of I_{in} input

2.10 Analog input I_{in} signal filter time

Filters out disturbances from the incoming analog I_{in} signal. Long filtering time makes regulation response slower. See figure 6.2-2.

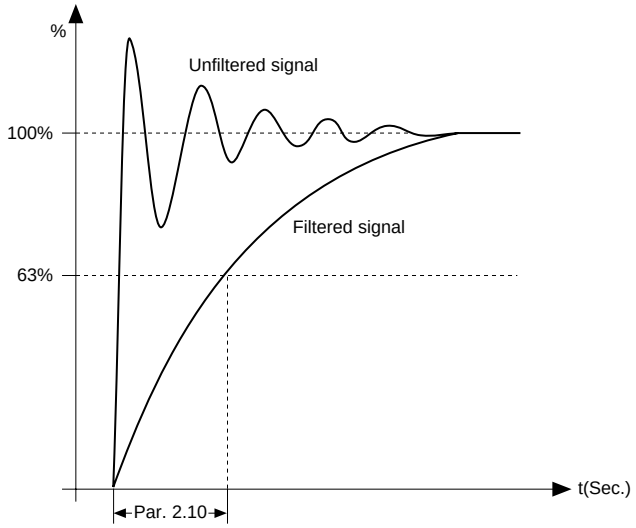


Figure 6.2-2: Analog input I_{in} Filter Time

2.11 V_{in} minimum scaling

Sets the minimum scaling point for V_{in} signal. See figure 6.2-3.

2. 12 V_{in} maximum scaling

Sets the maximum scaling point for V_{in} signal. See figure 6.2-3.

2. 13 I_{in} minimum scaling

Sets the minimum scaling point for I_{in} signal. See figure 6.2-3.

2. 14 I_{in} maximum scaling

Sets the maximum scaling point for I_{in} signal. See figure 6.2-3.

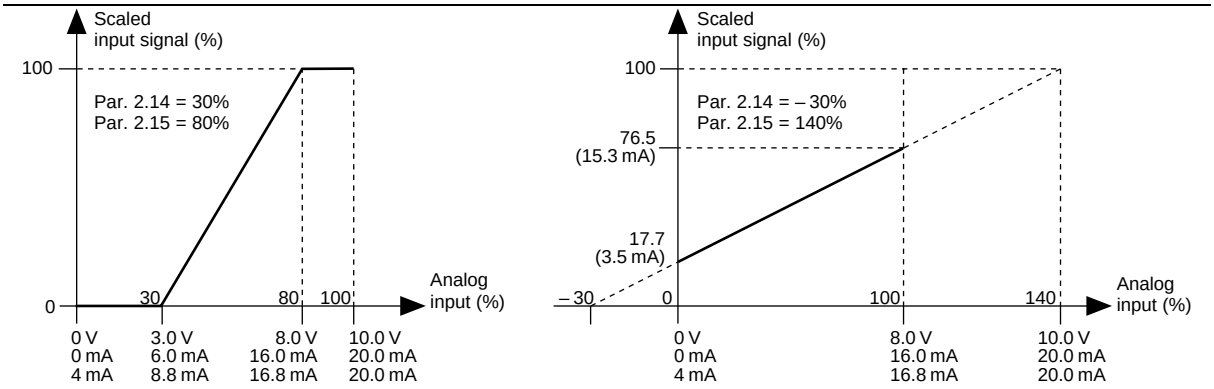


Figure 6.2-3: Examples of Scaling V_{in} and I_{in} Inputs

2.15 Free analog input, signal selection

Selection of input signal of free analog input (an input not used for reference signal):

0 = Not in use

1 = Voltage signal V_{in}

2 = Current signal I_{in}

3 = Voltage signal A_{in1} from terminals 202-203 of I/O Expander

4 = Analog signal A_{in2} from terminal 204-205 of I/O Expander
- current signal SV9IOC100CN
- voltage signal SV9IOC102CN

2.16 Free analog input, function

This parameter sets the function of the free analog input:

0 = Function is not used

1 = Reducing motor current limit (par. 1.7). This signal will adjust the maximum motor current between 0 and parameter max. limit set with parameter 1.7. See figure 6.2-4.

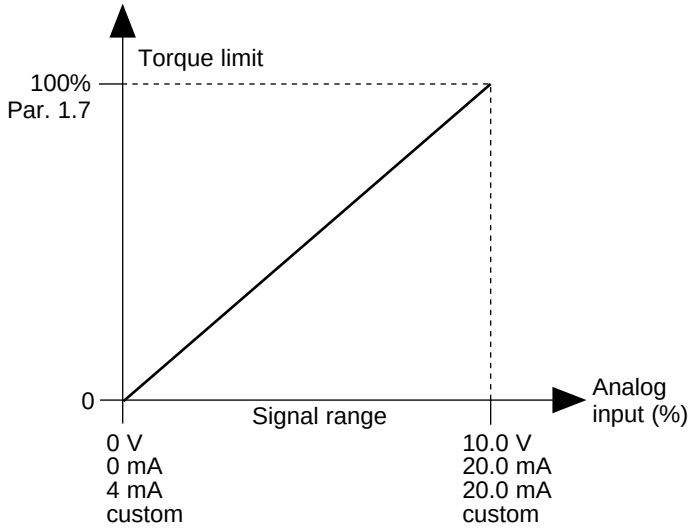


Figure 6.2-4: Reducing Maximum Motor Current

2 = Reducing DC brake current.
The DC braking current can be reduced with the free analog input signal, between $0.15xI_{nSV9}$ and current set with parameter 4.8. See figure 6.2-5.

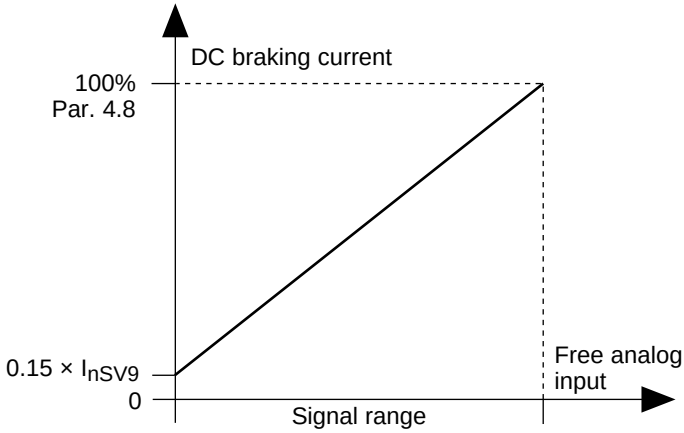


Figure 6.2-5: Reducing DC Brake Current

3 = Reducing acceleration and deceleration times.
The acceleration and deceleration times can be reduced with the free analog input signal, according to the following formula:

Reduced time =set acc./deceler. time (par. 1.3, 1.4; 4.3, 4.4)
divided by the factor R from figure 6.2-6.

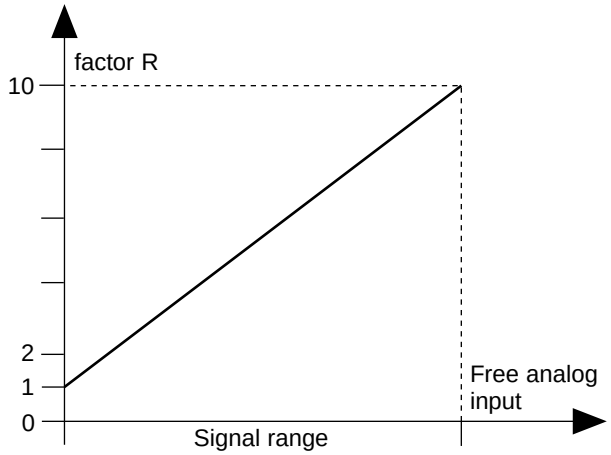


Figure 6.2-6: Reducing Acceleration and Deceleration Times

4 = Reducing torque supervision limit.
The set torque supervision limit can be reduced with the free analog input signal between 0 and set supervision limit (par. 3.11), see figure 6.2-7.

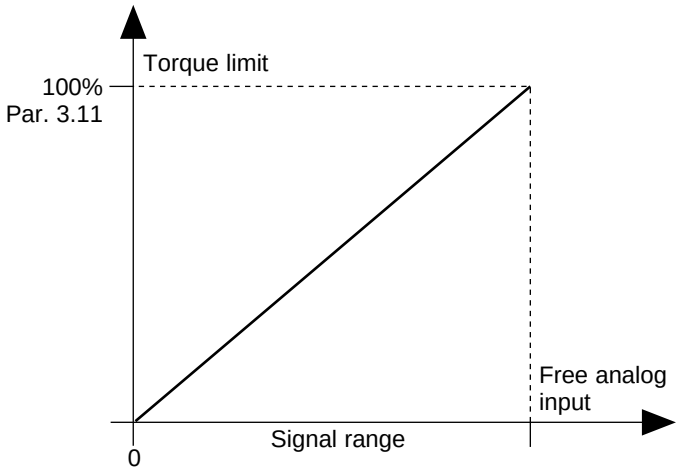


Figure 6.2-7: Reducing Torque Supervision Limit

2.17 Motorized potentiometer ramp time

Defines how fast the electronic motor potentiometer value changes.

2.18 Option board A_{in1} signal inversion

0 = no inversion

2.19 Option board A_{in1} signal filter time

Filters out disturbances from the incoming analog A_{in1} signal. Long filtering time makes regulation response slower.

2.20 Option board A_{in2} signal range

0 = 0—20 mA

1 = 4—20 mA

2 = 0—10 V (must be used with SV9IOC102CN)

2.21 Option board A_{in2} signal inversion

0 = no inversion

2.22 Option board A_{in2} signal filter time

Filters out disturbances from the incoming analog A_{in2} signal. Long filtering time makes regulation response slower.

6.2.2 Group 3, Analog Output and supervision parameters

3.1 Analog output function

See table “Group 3, Output and supervision parameters”.

3.2 Analog output filter time

Filters the analog output signal. See figure 6.2-8.

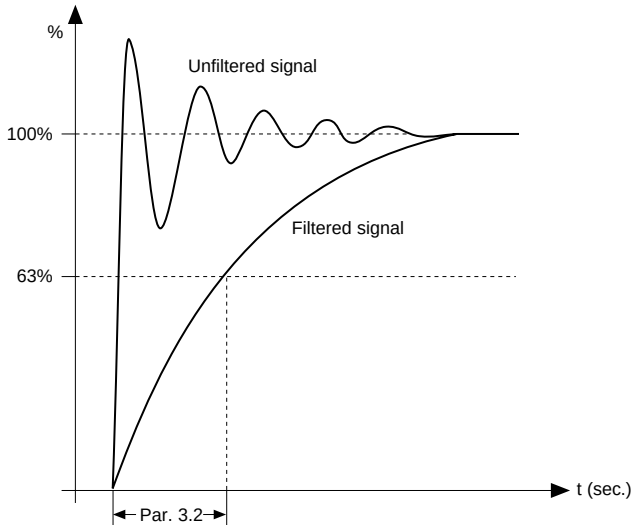


Figure 6.2-8: Analog Output Filtering

3.3 Analog output inversion

Inverts analog output signal:
See figure 6.2-9.

max. output signal = minimum set value

min. output signal = maximum set value

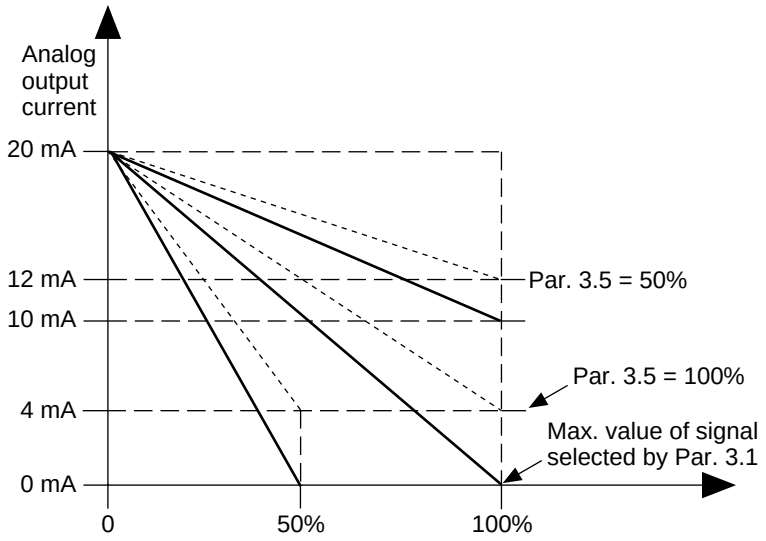


Figure 6.2-9 Analog Output Inversion

3.4 Analog output minimum

Defines the signal minimum to be either 0 mA or 4 mA (living zero). See figure 6.2-10.

3.5 Analog output scale

Scaling factor for analog output. See figure 6.2-10.

Signal	Max value of the signal
Output frequency	Max. frequency (p. 1. 2)
Motor speed	Max. speed (n_n x f_{max} /f_n)
Output current	2 x I_{nSV9}
Motor torque	2 x T_{nSV9}
Motor power	2 x P_{nSV9}
Motor voltage	100% x V_{nmotor}
DC-link voltage	1000 V
V_{in} signal	Max V_{in}
I_{in} signal	Max I_{in}

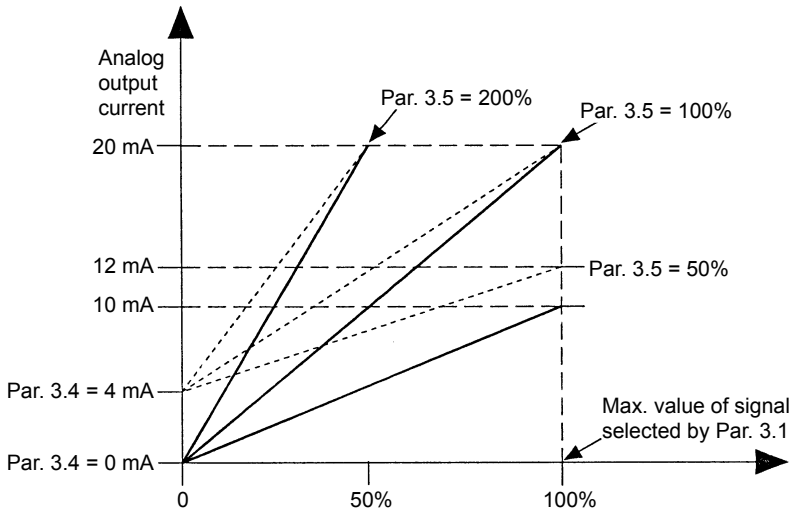


Figure 6.2-10 Analog output scale

3.6 Output freq. limit 1 supervision function

3.8 Output freq. limit 2 supervision function

0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the output frequency goes under/over the set limit (3.7, 3.9) this function generates a warning message via the digital output DO1 and via a relay output RO1 or RO2 depending on the setting of parameters 12.1ó12. 6.

3.7 Output freq. limit 1 supervision value

3.9 Output freq. limit 2 supervision value

The frequency value to be supervised by the parameter 3.6 or 3.8). See figure 6.2-11.

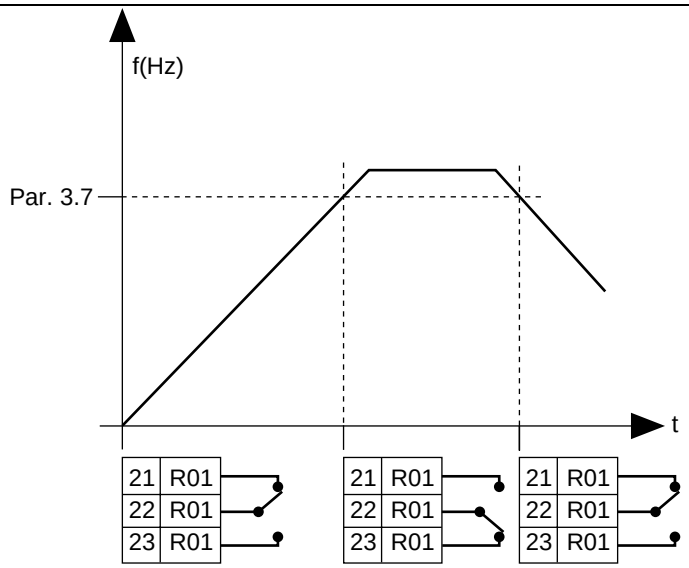


Figure 6.2-11: Output Frequency Supervision

3.10 Torque limit supervision function

0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the calculated torque value goes under/over the set limit (3.11) this function generates a warning message via the digital output DO1, via a relay output RO1 or RO2 depending on the setting of parameters 12.1—12.6.

3.11 Torque limit supervision value

The calculated torque value to be supervised by parameter 3.10

3.12 Reference limit supervision function

0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the reference value goes under/over the set limit (3.13) this function generates a warning message via the digital output DO1 or via a relay output RO1 or RO2 depending on the settings of parameters 12.1—12.6. The supervised reference is the currently active reference. It can be source A or B reference, depending on the DIB6 input, or the panel reference if the panel is the active control source.

3.13 Reference limit supervision value

The frequency value to be supervised by the parameter 3.12.

3.14 Extern. brake Off-delay

3.15 Extern. brake On-delay

With these parameters the timing of external brake can be linked to the Start and Stop control signals, see figure 6.2-12.

The brake control signal can be programmed via the digital output DO1 or via one of relay outputs RO1 and RO2, see parameters 12.1—12.6.

3.16 Frequency converter temperature limit supervision function

0 = No supervision

1 = Low limit supervision

2 = High limit supervision

If the temperature of the frequency converter goes under/over the set limit (3.17) this function generates a warning message via the digital output DO1 or via the relay outputs RO1 or RO2 depending on the settings of the parameters 12.1—12.6.

3.17 Frequency converter temperature limit value

The temperature value to be supervised by the parameter 3.16.

3.18 I/O-expander board (opt.) analog output content

3.19 I/O-expander board (opt.) analog output filter time

3.20 I/O-expander board (opt.) analog output inversion

3.21 I/O-expander board (opt.) analog output minimum

3.22 I/O-expander board (opt.) analog output scale

3.23 Analog output offset (basic control board)

3.24 I/O-expander board (opt.) analog output offset

With these parameters the offsets of the basic control board and I/O-Expander analog outputs can be set. See figure 6.2-12.

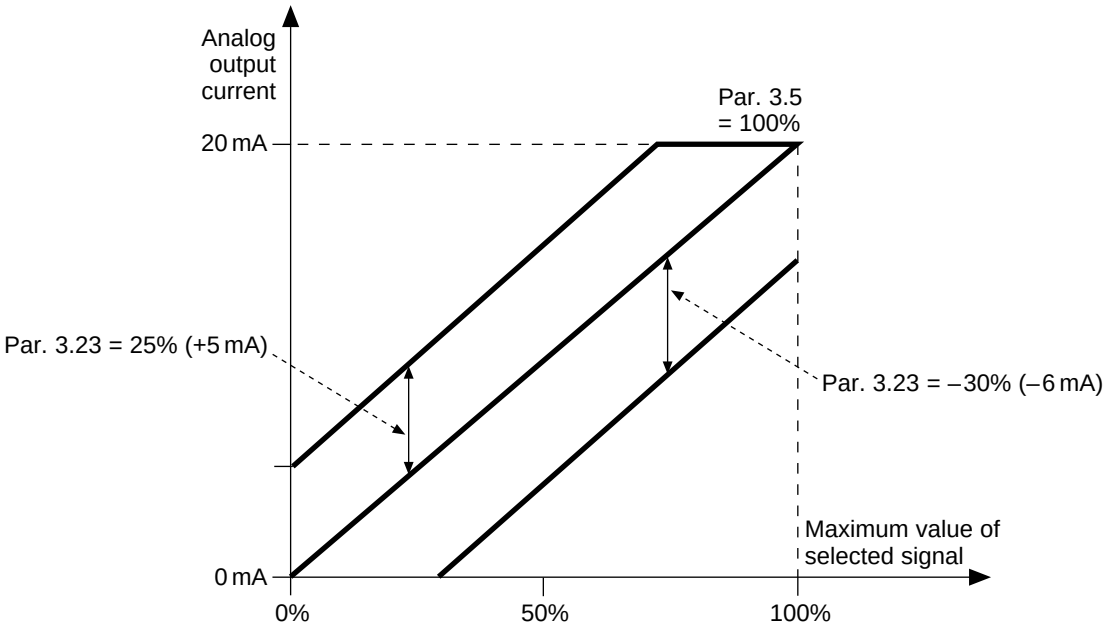


Figure 6.2-12: Analog Output Offset

6.2.3 Group 4, Drive Control Parameters

4.1 Acc./Dec. ramp 1 shape

4.2 Acc./Dec. ramp 2 shape

The start and end of the acceleration and deceleration ramps can be smoothed with these parameters. Setting value 0 gives linear ramp shape, which causes acceleration and deceleration to act immediately to the changes in the reference signal with the time constant set by the parameter 1.3 and 1.4 (4.3 and 4.4).

Setting value 0.1—10 seconds for parameters 4.1 or 4.2 causes linear acceleration or deceleration to adopt an S-shape. Parameters 1.3 and 1.4 (4.3 and 4.4) determines the time constant of acceleration/deceleration in the middle of the curve. See figure 6.2-13.

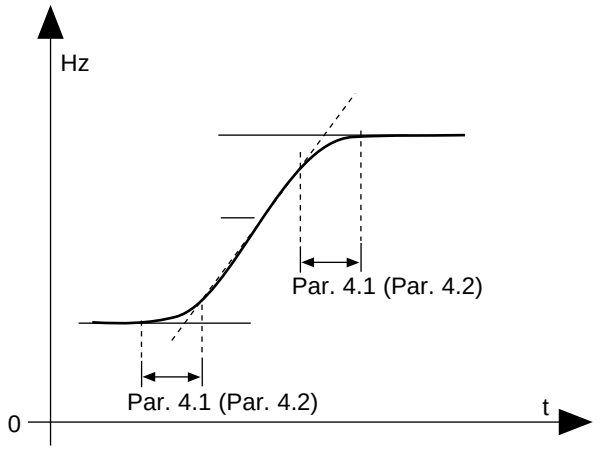


Figure 6.2-13: S-Shaped Acceleration/Deceleration

4.3 Acceleration time 2

4.4 Deceleration time 2

These values correspond to the time required for the output frequency to accelerate from the set minimum frequency (par. 1.1) to the set maximum frequency (par. 1.2). These times give the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable digital input of this application, see parameter group 11.

Acceleration/deceleration times can be reduced with an external free analog input signal, see parameters 2.13 and 2.14.

4.5 Brake chopper

0 = No brake chopper

1 = Brake chopper and brake resistor installed

2 = External brake chopper

When the frequency converter is decelerating the motor, the inertia of the motor and the load are fed into the external brake resistor. This enables the frequency converter to decelerate the load with the torque equal to that of acceleration, if the brake resistor is selected correctly. See separate Brake resistor installation manual.

4.6 Start function

Ramp:

0 The frequency converter starts from 0 Hz and accelerates to the set reference frequency within the set acceleration time. (Load inertia or starting friction may cause prolonged acceleration times).

Flying start:

1 The frequency converter is able to start into running motor by applying a small torque to motor and searching for frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter the output frequency will be accelerated/decelerated to the set reference value according to the set acceleration/deceleration parameters.

Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to ride through short utility voltage interruptions.

4.7 Stop function

Coasting:

0 The motor coasts to a halt without any control from the frequency converter, after the Stop command.

Ramp:

1 After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters. If the regenerated energy is high it may be necessary to use an external braking resistor for faster deceleration.

4.8 DC-braking current

Defines the current injected into the motor during the DC braking.

The DC braking current can be reduced from the setpoint with an external free analog signal, see parameters 2.15 and 2.16.

4.9 DC-braking time at Stop

Defines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, parameter 4.7. See figure 6.2-14.

0 DC-brake is not used

>0 DC-brake is in use and its function depends on the Stop function, (param. 4.7), and the time depends on the value of parameter 4.9:

Stop-function = 0 (coasting):

After the stop command, the motor coasts to a stop without any control from the frequency converter.

With DC-injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled according to the frequency when the DC-braking starts. If the frequency is $\geq$nominal frequency of the motor (par. 1.11), setting value of parameter 4.9 determines the braking time. When the frequency is $\leq$10% of the nominal, the braking time is 10% of the set value of parameter 4.9. See figure 6.2-14.

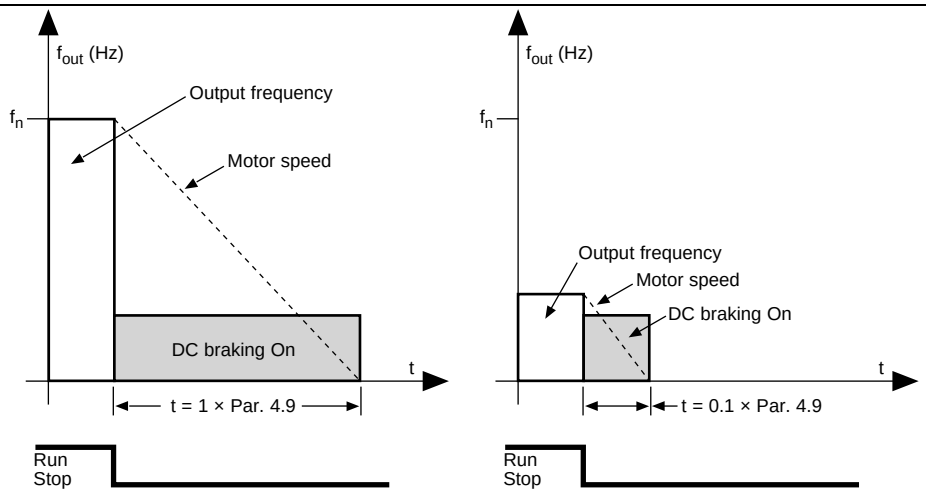


Figure 6.2-14: DC-Braking Time when Stop = Coasting

Stop-function = 1 (ramp):

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, as fast as possible, to a speed defined with the parameter 4**.** 10, where the DC-braking starts.

The braking time is defined with parameter 4.9.

If a high inertia exists, it is recommended to use an external braking resistor for faster deceleration. See figure 6.2-15.

4.10 Execute frequency of DC- brake during ramp Stop

See figure 6.2-15.

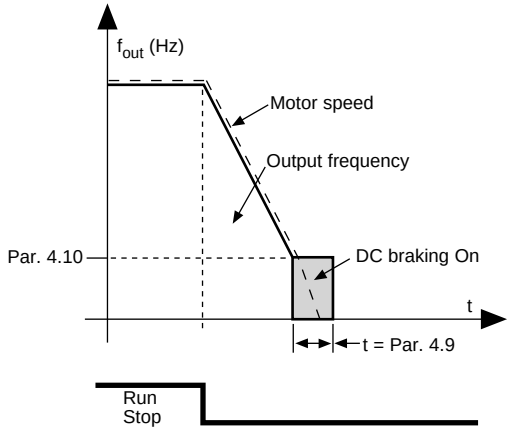


Figure 6.2-15: DC-Braking Time when Stop Function = Ramp

4.11 DC-brake time at Start

0 DC-brake is not used

>0 DC-brake is active when the start command is given and this parameter defines the time before the brake is released. After the brake is released, the output frequency increases according to the set start function parameter 4.6 and acceleration parameters (1.3, 4.1 or 4.2, 4.3), see figure 6.2-16.

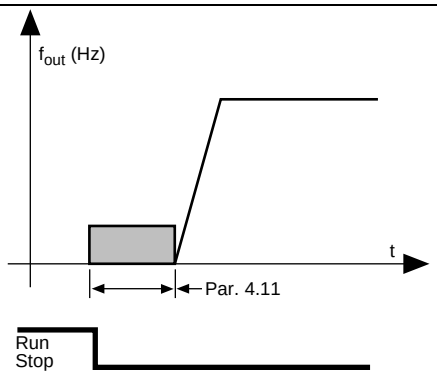


Figure 6.2-16: DC-Braking at Start

4.12 Multi-step speed reference 1

4.13 Multi-step speed reference 2

4.14 Multi-step speed reference 3

4.15 Multi-step speed reference 4

4.16 Multi-step speed reference 5

4.17 Multi-step speed reference 6

4.18 Multi-step speed reference 7

The parameter values define the Multi-Step speeds selected with the digital inputs.

The selection of Multi-Step speeds will occur similar to the description in the table *Multi-Step Application* on Page 3-8.

Refer to parameters 4.12 – 4.18.

6.2.4 Group 5, Prohibit Frequency Parameters

5.1 Prohibit frequency range 1 low limit

5.2 Prohibit frequency range 1 high limit

5.3 Prohibit frequency range 2 low limit

5.4 Prohibit frequency range 2 high limit

5.5 Prohibit frequency range 3 low limit

5.6 Prohibit frequency range 3 high limit

In some systems it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters it is possible to set limits for three "skip frequency" regions. See figure 6.2-17.

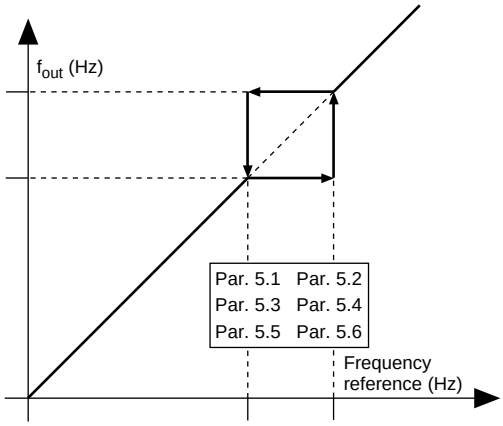


Figure 6.2-17: Example of Prohibit Frequency Area Setting.

6.2.5 Group 6, Motor Control Parameters

6.1 Motor control mode

0 = Frequency control:The I/O terminal and panel references are frequency references and the frequency converter controls the output frequency (output frequency resolution = 0.01 Hz)

1 = Speed control:The I/O terminal and panel references are speed references and the frequency converter controls the motor speed (regulation accuracy ± 0,5%).

6.2 Switching frequency

Motor noise can be minimized using a high switching frequency. Increasing the switching frequency reduces the capacity of the frequency converter unit.

Before changing the frequency from the factory default 10 kHz (3.6 kHz from 40 hp upwards), check the allowed capacity from the curve in the figure 5.2-3 of chapter 5.2 of the User's Manual.

6.3 Field weakening point

6.4 Voltage at field weakening point

The field weakening point is the output frequency at which the output voltage reaches the set maximum value (par. 6.4). Above that frequency the output voltage remains at the set maximum value. Below that frequency the output voltage depends on the setting of the V/Hz curve parameters 1.8, 1.9, 6.5, 6.6 and 6.7. See figure 6.2-18.

When the parameters 1.10 and 1.11, nominal voltage and nominal frequency of the motor, are set, parameters 6.3 and 6.4 are set automatically to the corresponding values. If different values for the field weakening point and the maximum output voltage are required, change these parameters after setting the parameters 1.10 and 1.11.

6.5 V/HZ-curve mid-point frequency

If the programmable V/Hz curve has been selected with the parameter 1.8 this parameter defines the middle point frequency of the curve. See figure 6.2-18.

6.6 V/HZ-curve mid-point voltage

If the programmable V/Hz curve has been selected with the parameter 1.8 this parameter defines the middle point voltage of the curve. See figure 6.2-18.

6.7 Output voltage at zero frequency

If the programmable V/Hz curve has been selected with the parameter 1.8 this parameter defines the zero frequency voltage. See figure 6.2-18.

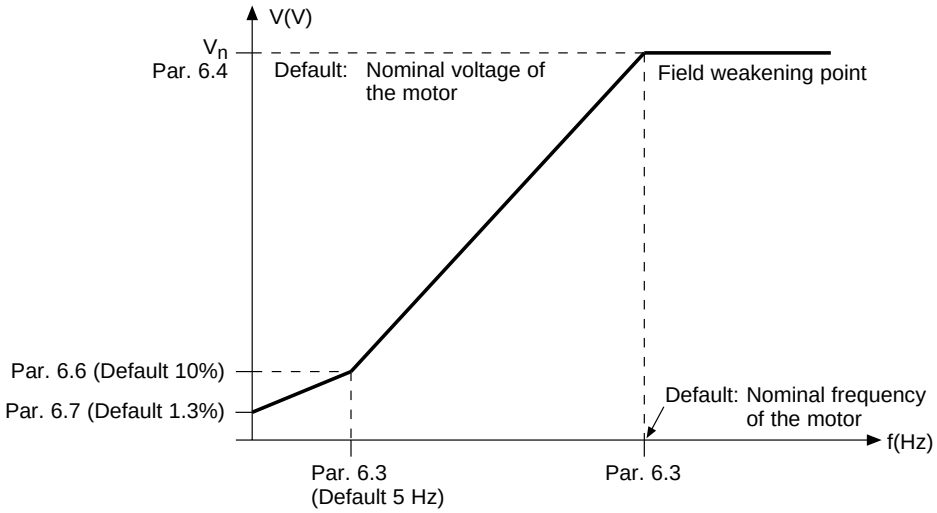


Figure 6.2-18: Programmable V/Hz Curve

6.8 Overvoltage controller

6.9 Undervoltage controller

These parameters allow the over-/undervoltage controllers to be switched off. This may be useful, for example, if the utility supply voltage varies more than -15%—+10% and the application will not tolerate this over-/undervoltage. The controller changes the output frequency according to the supply fluctuations.

Over-/undervoltage trips may occur when controllers are switched out of operation.

6.2.6 Group 7, Protections

7.1 Response to reference fault

0 = No response

1 = Warning

2 = Fault, stop mode after fault according to parameter 4.7

3 = Fault, stop mode after fault always by coasting

A warning or a fault action and message is generated if the 4—20 mA reference signal is used and the signal falls below 4 mA. The information can also be transmitted via digital output DO1 or via relay outputs RO1 and RO2.

7.2 Response to external fault

0 = No response

1 = Warning

2 = Fault, stop mode after fault according to parameter 4.7

3 = Fault, stop mode after fault always by coasting

A warning or a fault action and message is caused by the external fault signal in the digital input DIA3. The information can also be transmitted via digital output DO1 or via relay outputs RO1 and RO2.

7.3 Phase supervision of the motor

0 = No action

2 = Fault

Phase supervision of the motor ensures that the motor phases have approximately equal current.

7.4 Earth fault protection

0 = No action

2 = Fault

Ground fault protection ensures that the sum of the motor phase currents is zero. The protection is always active and protects the frequency converter from ground faults with high currents.

7.5-7.9 General

The motor thermal protection is to protect the motor from overheating. The SV9000 drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that motor will be thermally overloaded. This is true especially at low frequencies. At low frequencies the cooling effect of the motor is reduced, reducing the capacity of the motor. If the motor is equipped with an external fan the capacity reduction at low speeds is small.

The motor thermal protection is based on a calculated model and it uses the output current of the drive to determine the load on the motor. When the power of the drive is turned on, the model uses the heatsink temperature to determine the initial thermal state of the motor. The calculated model assumes that the ambient temperature of the motor is 40°C.

The motor thermal protection can be adjusted by setting the following parameters. The thermal current I_T specifies the load current above which the motor is overloaded. This thermal current limit is a function of the output frequency. The curve for I_T is set with parameters 7.6, 7.7 and 7.9, see figure 6.2-19. The parameter default values are taken from the motor name plate data.

With the output current at I_T the thermal state will reach the nominal value (100%). The thermal state changes proportionally to the square of the current. With output current at 75% of I_T the thermal state will reach 56% value and with output current at 120% of I_T the thermal state would reach 144% value. The function will trip the drive (see par. 7.5) if the thermal state reaches a value of 105%. The speed of change in the thermal state is determined by the time constant parameter 7.8. The bigger the motor the longer it takes to reach the final temperature.

The thermal state of the motor can be monitored through the display. See the table for monitoring items. (User's Manual, table 7.3-1).

CAUTION! The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill.

7.5 Motor thermal protection

Operation:
0 = Not in use

1 = Warning

2 = Trip function

Tripping and warning will display the same message code. If tripping is selected the drive will stop and activate the fault stage.

Deactivating the protection, setting the parameter to 0, will reset the thermal stage of the motor to 0%.

7.6 Motor thermal protection break point current

The current can be set between 50.0—150.0% x I_{nMotor}.
This parameter sets the value for thermal current at frequencies above the breakpoint on the thermal current curve. See figure 6.2-19.

The value is set in percentage which refers to the name plate data of the motor, parameter 1.13, nominal current of the motor, not the drive's nominal output current.

The motor's nominal current is the current which the motor can withstand in direct on-line use without being overheated.

If parameter 1.13 is adjusted, this parameter is automatically restored to the default value.

Setting this parameter (or parameter 1.13) does not affect the maximum output current of the drive. Parameter 1.7 alone determines the maximum output current of the drive.

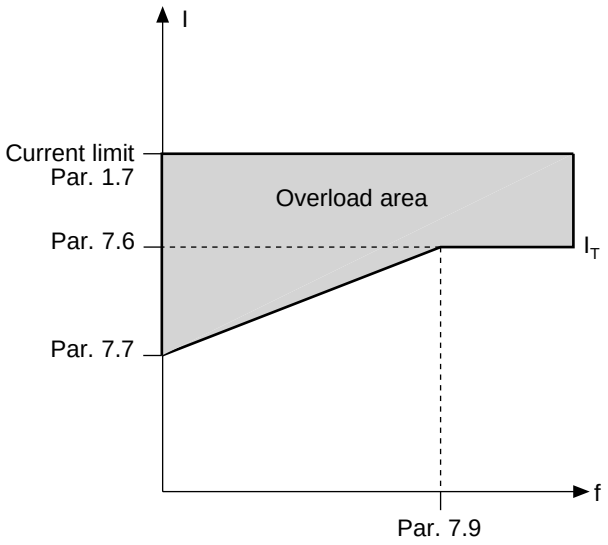


Figure 6.2-19: Motor Thermal Current I_T Curve

7.7 Motor thermal protection zero frequency current

The current can be set between 10.0—150.0% x I_{nMotor}. This parameter sets the value for thermal current at zero frequency. See figure 6.2-19.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

The value is set as a percentage of the motor name plate data, parameter 1.13, motor's nominal current, not the drive's nominal output current. The motor's nominal current is the current that the motor can stand in direct on-line use without being overheated.

If you change the parameter 1.13, this parameter is automatically restored to the default value.

Setting this parameter (or parameter 1.13) does not affect to the maximum output current of the drive. Parameter 1.7 alone determines the maximum output current of the drive.

7.8 Motor thermal protection time constant

This time can be set between 0.5—300 minutes.
This is the thermal time constant of the motor. The bigger the motor the bigger the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

The motor thermal time is specific for the motor design and it varies between different motor manufacturers.

The default value for the time constant is calculated based on the motor name plate data given with parameters 1.12 and 1.13. If either of these parameters is set, this parameter is set to its default value.

If the motor's t_6 -time is known (given by the motor manufacturer) the time constant parameter could be set basing on t_6 -time. As a rule of thumb, the motor thermal time constant in minutes equals to 2 x t_6 (t_6 in seconds is the time a motor can safely operate at six times the rated current). If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in the stop stage is based on convection and the time constant is increased.

7.9 Motor thermal protection break point frequency

The frequency can be set between 10—500 Hz.

This is the breakpoint of thermal current curve. With frequencies above this point the thermal capacity of the motor is assumed to be constant. See figure 6.2-20.

The default value is based on the motor's name plate data, parameter 1.11. It is 35 Hz for a 50 Hz motor and 42 Hz for a 60 Hz motor. More generally it is 70% of the frequency at field weakening point (parameter 6.3). Changing either parameter 1.11 or 6.3 will restore this parameter to its default value.

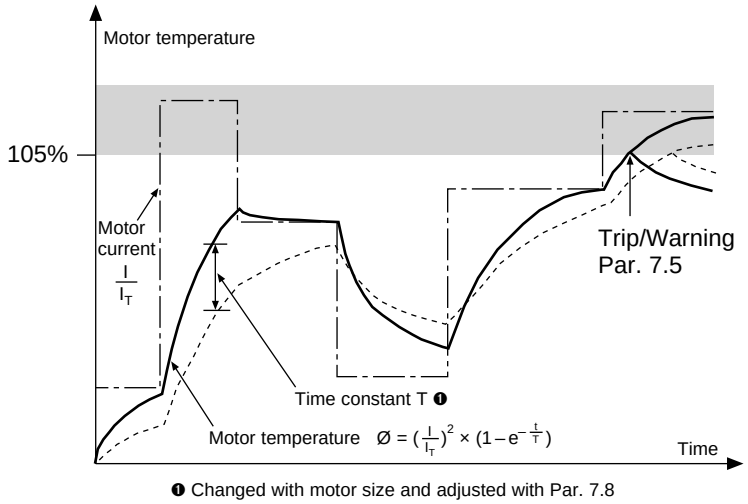


Figure 6.2-20: Calculating Motor Temperature

Parameters 7. 10— 7. 13, Stall protection

General

Motor stall protection protects the motor from short time overload situations like a stalled shaft. The reaction time of stall protection can be set shorter than with motor thermal protection. The stall state is defined with two parameters: 7.11 Stall Current, and 7.13 Stall Frequency. If the current is higher than the set limit and output frequency is lower than the set limit, the stall state is true. There is actually no real indication of the shaft rotation. Stall protection is a type of overcurrent protection.

7.10 Stall protection

Operation:

0 = Not in use

1 = Warning

2 = Trip function

Tripping and warning will display the same message code. If tripping is set on, the drive will stop and activate the fault stage. Setting the parameter to 0 will deactivate the protection and will reset the stall time counter to zero.

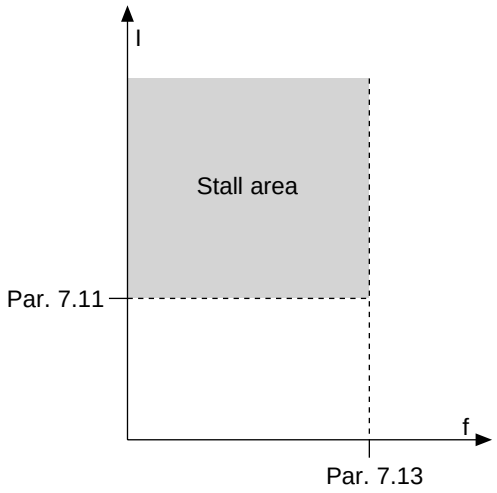


Figure 6.2-21: Setting the Stall Characteristics

7.11 Stall current limit

The current can be set to 0.0—200% x I_{nMotor}.

In a stall state the current is above this limit. See figure 6.2-21. The value is set as a percentage of the motor's name plate data, parameter 1.13, motor's nominal current. If parameter 1.13 is adjusted, this parameter is automatically restored to the default value.

7.12 Stall time

The time can be set between 2.0—120 s.
This is the maximum allowed time for a stall stage. There is an internal up/down counter to count the stall time. See figure 6.2-22. If the stall time counter value goes above this limit the protection will cause a trip (see parameter 7.10).

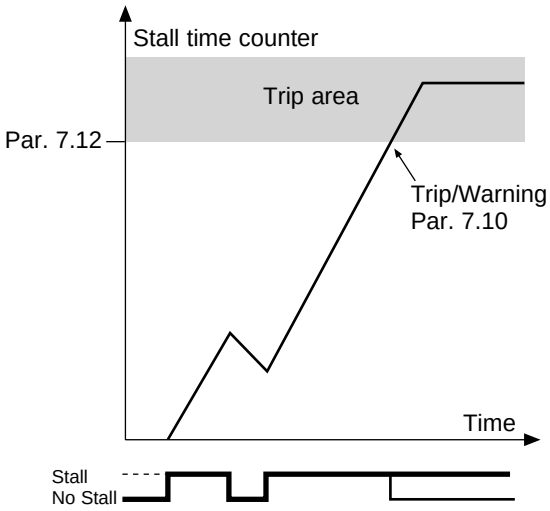


Figure 6.2-22: Counting the Stall Time

7.13 Maximum stall frequency

The frequency can be set between 1—f_{max} (par. 1.2).

In a stall state, the output frequency is smaller than this limit. See figure 6.2-21.

Parameters 7.14—7.17, Underload protection

General

The purpose of motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load there might be a problem in the process, e.g. a broken belt or dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters 7.15 and 7.16. The underload curve is a squared curve set between zero frequency and the field weakening point. The protection is not active below 5Hz (the underload counter value is stopped). See figure 6.2-23.

The torque values for setting the underload curve are set in percentage of the nominal torque of the motor. The motor's name plate data, parameter 1.13, the motor's nominal current and the drive's nominal current I_{CT} are used to find the scaling ratio for the internal torque value. If other than nominal motor is used with the drive, the accuracy of the torque calculation decreases.

7.14 Underload protection

Operation:

0 = Not in use

1 = Warning

2 = Fault

Tripping and warning will display the same message code. If tripping is set active the drive will stop and activate the fault stage.

Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero.

7.15 Underload prot., field weakening area load

Operation:

0 = Not in use

1 = Warning

2 = Fault

Tripping and warning will display the same message code. If tripping is set active the drive will stop and activate the fault stage.

Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero.

7.16 Underload protection zero frequency load

The torque limit can be set between 10.0—150 % x T_{nMotor}.

This parameter gives value for the minimum torque allowed with zero frequency. See figure 6-30. If parameter 1.13 is adjusted this parameter is automatically restored to the default value.

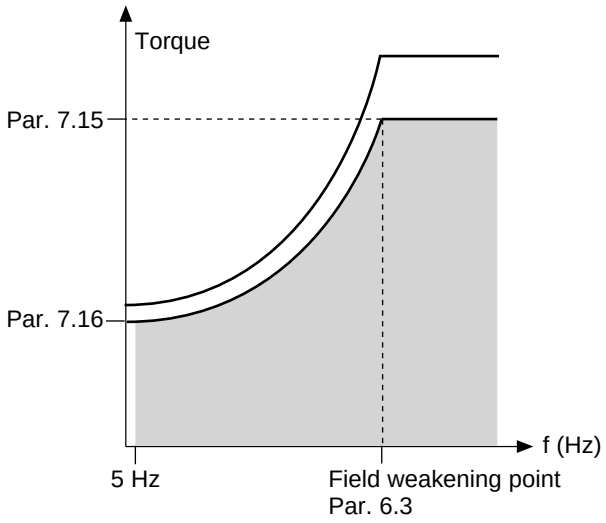


Figure 6.2-23: Setting of Minimum Load

7.17 Underload time

This time can be set between 2.0—600.0 s.

This is the maximum allowed time for an underload state. There is an internal up/down counter to accumulate the underload time. See figure 6.2-24. If the underload counter value goes above this limit the protection will cause a trip (refer to the parameter 7.14). If the drive is stopped the underload counter is reset to zero.

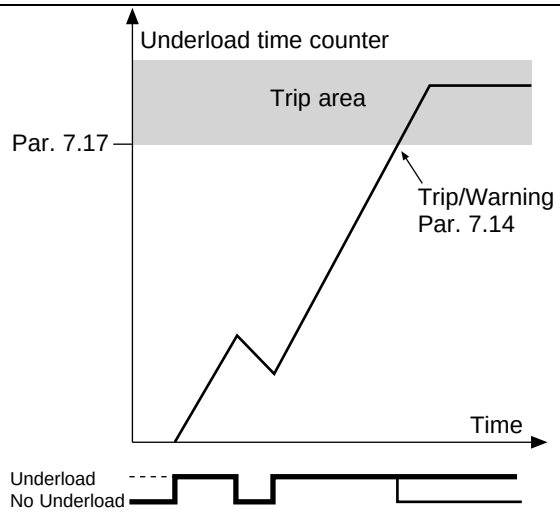


Figure 6.2-24: Counting the Underload Time.

7.18 Phase supervision of the supply voltage

0 = No action

2 = Fault

By setting the parameter value to zero, the phase supervision of the supply voltage will not cause tripping

7.19 Thermistor input of I/O-Expander

0 = No action

1 = Warning

2 = Fault

The thermistor connected to the thermistor input of the I/O-expander board supervises the temperature of the motor. With parameter 7.19 the response of the frequency converter can be programmed when the thermistor indicates overtemperature.

7.20 Response to fieldbus fault

0 = No response

1 = Warning message

2 = Fault message, stop mode after fault according to parameter 4.7. A warning or a fault action and message is generated from the fieldbus card if the error occurs of the bus system physical layer.

6.2.7 Group 8, Autorestart Parameters

8.1 Automatic restart: number of tries

8.2 Automatic restart: trial time

The Automatic restart function restarts the frequency converter after the faults selected with parameters 8.4—8.8. The Start function for Automatic restart is selected with parameter 8.3.

Parameter 8.1 determines how many automatic restarts can be made during the trial time set by the parameter 8.2.

The time counting starts from the first auto-restart. If the number of restarts does not exceed the value of the parameter 8.1 during the trial time, the counting is cleared after the time is elapsed and next fault starts the counting again.

8.3 Automatic restart: start function

The parameter defines the start mode:

0 = Start with ramp

1 = Flying start, see parameter 4.6.

8.4 Automatic restart of undervoltage

0 = No automatic restart after undervoltage fault trip

1 = Automatic restart after undervoltage fault condition returns to normal condition (DC-link voltage returns to the normal level)

8.5 Automatic restart of overvoltage

0 = No automatic restart after overvoltage fault trip

1 = Automatic restart after overvoltage fault condition returns to the normal condition (DC-link voltage returns to the normal level)

8.6 Automatic restart of overcurrent

0 = No automatic restart after overcurrent fault trip

1 = Automatic restart after overcurrent faults

8.7 Automatic restart of reference fault

0 = No automatic restart after reference fault trip

1 = Automatic restart after analog current reference signal (4—20 mA) returns to the normal level ($\geq$4 mA)

8.8 Automatic restart after over/undertemperature fault

0 = No automatic restart after temperature fault trip

1 = Automatic restart after heatsink temperature has returned to its normal level between -10°C—+75°C.

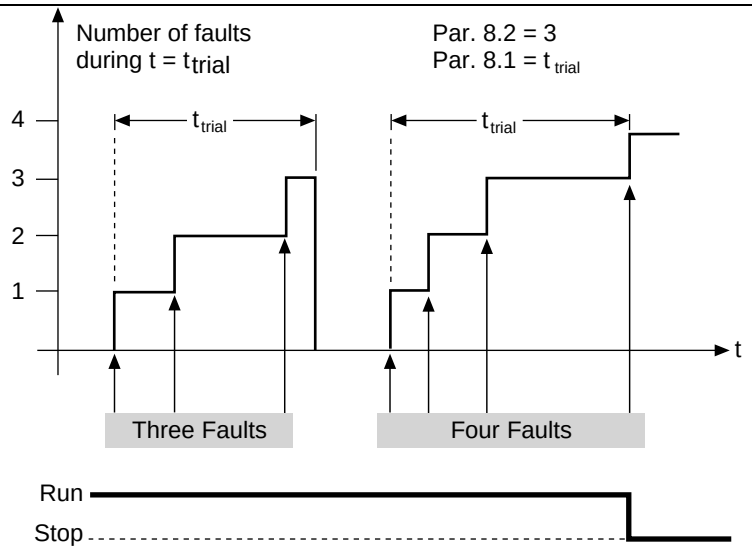


Figure 6.2-25: Automatic restart

6.2.8 Group 9, Torque Control

Torque Control

Torque control can be activated either by setting parameter 6.1 to torque control or with digital input DIA3 (parameter 2.2=10). The torque reference source is selected with parameter 9.1 and reference scaling with parameters 9.2 and 9.3.

9.1 Torque reference selection

Defines the source for torque reference value:

0 = None

1 = V_{in}

2 = I_{in}

9.2 Torque reference scaling bias

9.3 Torque reference scaling gain

The additional scaling function can be used for scaling the torque reference. The torque reference is always fed to the torque controller even if it is not activated.
$T_{ref.\ out}$ = gain × $T_{ref.\ in}$ + bias

9.4 TC time constant

Defines the time constant for the torque controller. A short time constant means fast response.

9.5 TC min. control limit

Defines frequency limit below, which the frequency converter operates normally in frequency control mode.

The internal torque calculation is inaccurate at low speeds (< nominal slip of the motor). It is recommended to operate in frequency control operation mode at low speeds.

The reference value in frequency controlled operation mode is selected with parameter 1.5.

6.2.9 Group 10, Fieldbus Parameters

Fieldbus control

Fieldbus control can be activated with parameter 10.1. Then the frequency or speed reference comes from the fieldbus as well as the Start/Stop and Reverse control.

The first two parameters in group 10 concern all fieldbuses. Parameters 10.3 - 10.6 are only for Modbus, parameters 10.7 - 10.13 only for Profibus and 10.14 only for LonWorks.

10.1 Fieldbus control select

Defines the active control source:

0: control via I/O terminals

1: control via fieldbus board

10.2 MODBUS Slave address

0: Fieldbus control, contact open = Active control source are I/O terminals contact closed = Active control source is the Fieldbus board

1: External Fault, closing contact = Fault is shown and motor is stopped when the input is active

10.3 Baud rate

1: 300 baud

2: 600 baud

3: 1200 baud

4: 2400 baud

5: 4800 baud

6: 9600 baud

7: 19200 baud

10.4 Modbus Parity type

0: None

1: Even

2: Odd

10.5 Modbus time-out

The Modbus time-out determines how long the fieldbus board waits for a message from a master device and is specified in seconds.

Time can be set between 0 - 3600 s. Time 0 s = No time-out

Parameters 10.7 to 10.13 only for Profibus DP protocol

10.6 Profibus slave address

Defines slave device address. Maximum value for this parameter is 126 and minimum 2

10.7 Profibus baud rate

1: 9.6 kbaud

2: 19.2 kbaud

3: 93.75 kbaud

4: 187.5 kbaud

5: 500 kbaud

6: 1.5 Mbaud

7: 3 Mbaud

8: 6 Mbaud

9: 12 Mbaud

10: AUTO (Automatic baud rate select)

10.8 Profibus PPO Type

Selection of Profibus PPO type.

1: PPO 1 (Parameter data 8 bytes, Control data 4 bytes)

2: PPO 2 (Parameter data 8 bytes, Control data 4 bytes)

3: PPO 3 (Control data 4 bytes)

4: PPO 4 (Control data 12 bytes)

10.9 Profibus Process Data 1

10.10 Profibus Process Data 2

10.11 Profibus Process Data 3

10.12 Profibus Process Data 4

Selection of Profibus process data source.

Value 1...22 Number of actual value (= n1 ... n22 in monitor page)

99 Active fault code

10.13 LonWorks Service Button

Changing the value of this parameter from 0 to 1 or vice versa and pressing the Enter button causes the unique LonWorks ID number to be sent to the network.

6.2.10 Group 11, Digital Input Parameters

11.1 DIA2 function

1: External fault, closing contact = Fault is shown and motor is stopped when the input is active.

2: External fault, opening contact = Fault is shown and motor is stopped when the input is not active.

3: Run enable, contact open = Motor run disabled
contact closed = Motor run enabled

4: Acc./Dec, contact open = Acceleration/deceleration time 1 selected
time select.contact closed = Acceleration/deceleration time 2 selected

5: Reverse contact open = forward
contact closed = reverse

6: Jog Speed contact closed = Jogging speed selected for freq. reference

7: Fault reset contact closed = Resets all faults

8: Acc./Dec. operation prohibited
contact closed =Stops acceleration or deceleration until the contact is opened

9: DC-braking command
contact closed =In Stop mode, the DC-braking operates until the contact is opened, see figure 6.2-26. DC-brake current is set with parameter 4.8.

10: Torque control
contact closed = Forces the motor control mode to torque control, refer to par. 6.1

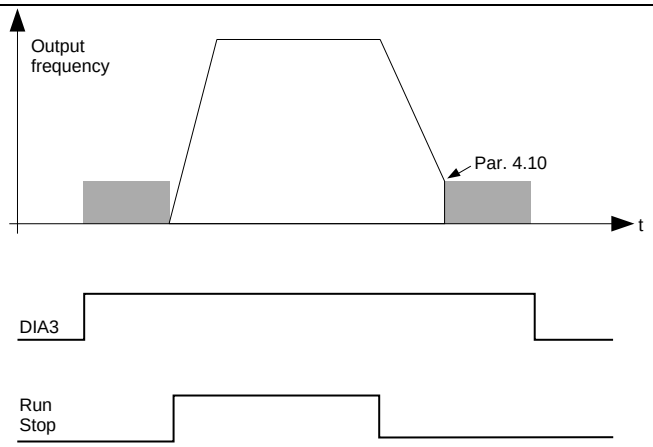
11: Hot Motor Detection: NC contact open = hot motor detected. Warning or Fault displayed based on P7.21 selection.

12: Hot Bearing Detection: NC contact open = hot bearing detected. Warning or Fault displayed based on P7.22 selection.

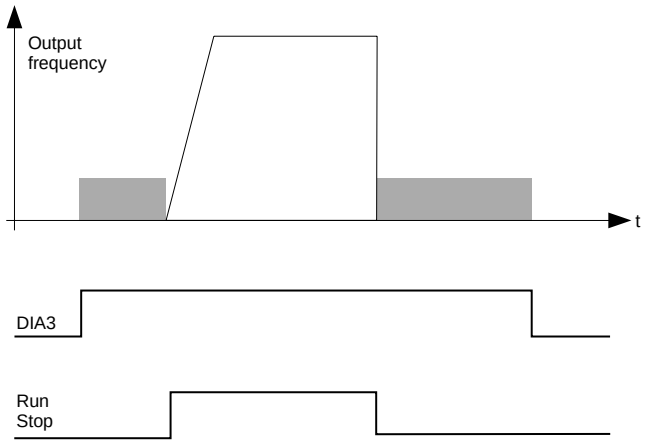
13: Seal Leak Detection: NO contact closed = Warning or Fault displayed based on P7.23 selection.

14: High Vibration Detection: NO contact closed = Warning or Fault displayed based on P7.24 selection.

15: Multi-Step 1 = *Multi-Step contact closed* = *Selection 1 active* (refer to par. 4.12 – 4.18)



a) DIA3 as DC-brake command and stop mode = Ramp



b) DIA3 as DC-brake command input and stop mode = Coasting

Figure 6.2-26: DIA3 as DC-Brake Command Input: a) Stop-Mode = Ramp, b) Stop-Mode = Coasting

11.2 DIB4 function (terminal 14)

Selections are same as 11.1 except:

10: Torque Reference Signal = Postive or negative torque reference signal
11: Hot Motor Winding, NC Normally Closed Contact
12: Hot Motor Bearing, NC Normally Closed Contact
13: Seal Leak Detection, NO Normally Open Contact
14: High Vibration Detection, NO Normally Open Contact
15: Multi-Step 2 = *Multi-Step contact closed = Selection 2 active*
(Refer to definitions 4.12 – 4.18)

11.3 DIB5 function (terminal 15)

Selections are same as 11.1 except:

10: Internal Motor Speed Pot Up =
11: Seal Leak Detection, NC Normally Closed Contact
12: High Vibration Detection, NC Normally Closed Contact
13: Hot Motor Detection, NO Normally Open Contact
14: Hot Bearing Detection, NO Normally Open Contact
15: Multi-Step 3 = *Multi-Step contact closed = Selection 3 active*
(Refer to definitions 4.12 – 4.18)

11.4 DIB6 function (terminal 16)

Selections are the same as 11.3 except:

10: Motorized Pot. Down =

11.5 DIC1 function *(Refer to page 16)*

Selections are the same as 11.1 except:

10: Multi-Step 1 contact closed = Selection 1 active (speed select 1)
11: Internal Motor Speed Pot. Up, contact closed = Reference increases until the contact is opened
12: Hot Motor Detection, NC contact =
13: Hot Motor Bearing Detection, NC contact =
14: Seal Leak Detection, NO contact =
15: High Vibration Detection, NO contact =

11.6 DIC2 function

0: Run Enable, Open
1: Ext. fault, closing contact
2: External fault, opening contact
3: Run Enable, Close
4: Acc./dec. time selection
5: Reverse
6: Jogging speed select
7: Fault reset
8: Acc./dec. operation prohibit
9: DC-braking command
10: Multi-Step Speed Select 2
11: Motorized pot. speed down
12: Hot Motor Detection - Open Contact
13: Hot Motor Bearing - Open Contact
14: Seal Leak Detection - Closed Contact
15: High Vibration - Closed Contact

11.7 Hot Motor Winding Delay

11.8 Hot Motor Bearing Delay

11.9 Seal Leak Detection Delay

11.10 High Vibration Delay

These parameters set the delay time before the fault is activated.

6.2.11 Group 12, Digital Output Parameters

12.1 Digital output function

Selections 0 – 27 from Parameter Setting Descriptions table below.

12.2 Relay output function

Selections 0 – 27 from Parameter Setting Descriptions table below.

12.3 Relay 2 output function

Selections 0 – 27 from Parameter Setting Descriptions table below.

12.4 Relay 3 output function

Selections 0 – 27 from Parameter Setting Descriptions table below.

12.5 Relay 4 output function

Selections 0 – 27 from Parameter Setting Descriptions table below.

12.6 Relay 5 output function

Selections 0 – 27 from Parameter Setting Descriptions table below.

Setting value	Signal content
0 = Not used	Out of operation
Digital output DO1 sinks the current and programmable relay (RO1, RO2) is activated when:	
1 = Ready	The frequency converter is ready to operate
2 = Run	The frequency converter operates (motor is running)
3 = Fault	A fault trip has occurred
4 = Fault inverted	A fault trip has not occurred
5 = SV9000 overheat warning	The heat-sink temperature exceeds +70°C
6 = External fault or warning	Fault or warning depending on parameter 7.2
7 = Reference fault or warning	Fault or warning depending on parameter 7.1 - if analog reference is 4 – 20 mA and signal is <4mA
8 = Warning	Always if a warning exists
9 = Reversed	The reverse command has been selected
10 = Jogging speed	Jogging speed has been selected with digital input
11 = At speed	The output frequency has reached the set reference
12 = Motor regulator activated	Overvoltage or overcurrent regulator was activated
13 = Output frequency supervision 1	The output frequency goes outside of the set supervision. Low limit/ High limit (par. 3.6 and 3.7)
14 = Output frequency supervision 2	The output frequency goes outside of the set supervision. Low limit/ High limit (par. 3.8 and 3.9)
15 = Torque limit supervision	The motor torque goes outside of the set supervision. Low limit/ High limit (par. 3.10 and 3.11)
16 = Reference limit supervision	Reference goes outside of the set supervision. Low limit/ High limit (par. 3.12 and 3.13)
17 = External brake control	External brake ON/OFF control with programmable delay (par 3.14 and 3.15)
18 = Control from I/O terminals	External control mode selected with progr. push-button #2
19 = Temperature Limit Supervision	Temperature on frequency converter goes outside the temperature limit supervision set supervision limits (par. 3.16 and 3.17)
20 = Unrequested rotation direction	Rotation direction of the motor shaft is different from the requested one
21 = External brake control inverted	External brake ON/OFF control (par. 3.14 and 3.15), output active when brake control is OFF
22 = Thermistor fault or warning	The terminator input of option board indicates overtemperature. Fault or warning depending on parameter 7.19
23 = Hot Motor Winding Fault	A hot motor winding fault has tripped
24 = Hot Motor Bearing Fault	A hot motor bearing fault has tripped
25 = Seal Seat Detection Fault	A seal leak detection fault has tripped
26 = High Vibration Fault	A high vibration fault has tripped
27 = Warn Flash	Output will toggle in Flash mode

Parameter Settings Descriptions

12.7 Digital output DO1 on delay

12.8 Digital output DO1 off delay

12.9 Relay output RO1 on delay

12.10 Relay output RO1 off delay

12.11 Relay output RO2 on delay

12.12 Relay output RO2 off delay

12.13 Relay output RO3 on delay

12.14 Relay output RO3 off delay

12.15 Relay output RO4 on delay

12.16 Relay output RO4 off delay

12.17 Relay output RO5 on delay

12.18 Relay output RO5 off delay

With these parameters it is possible to set on- and off-delays for the digital and relay outputs. See figure 6.2-27.

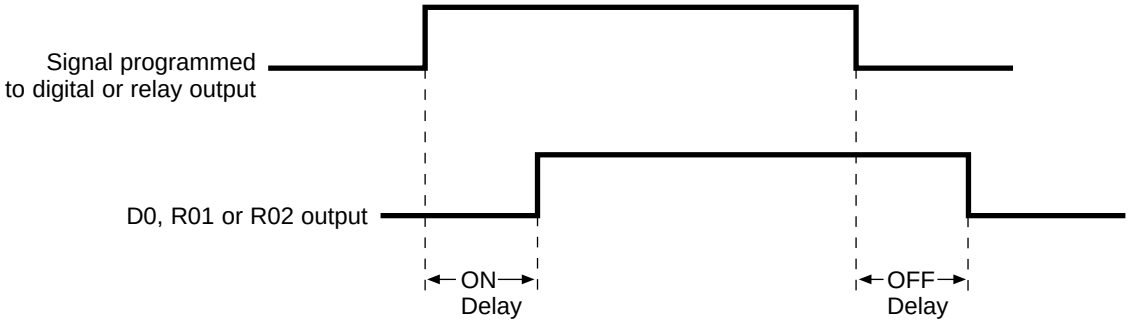


Figure 6.2-27. Digital and Relay Output On- and Off-Delays

7 Fault Code

The Motor Pump Enhanced Protection application has some extra fault codes:

Fault Number	Fault	Possible Cause	Check
27	Fieldbus communication error	Fieldbus board has detected the reset of error of the Bus system (physical layer)	Reset the fault and restart again. If the fault comes again: - check the host system – check the cables
50	Hot Motor Winding	I/O detected a fault at this input	Verify settings in group 11
51	Hot Motor Bearing	I/O detected a fault at this input	Verify settings in group 11
52	Seal Leak Detection	I/O detected a fault at this input	Verify settings in group 11
53	High Vibration	I/O detected a fault at this input	Verify settings in group 11

8 Monitoring Data

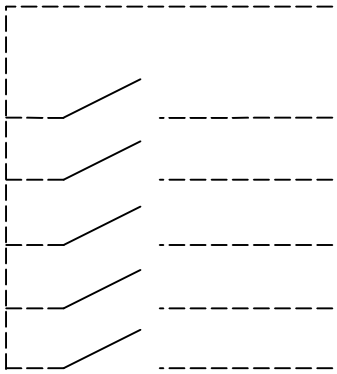
The Multipurpose Application II has extra items for monitoring (n21 - n22). See table 8-1.

Data Number	Data Name	Unit	Description
V1	Output frequency	Hz	Frequency to the motor
V2	Motor speed	rpm	Calculated motor speed
V3	Motor current	A	Measured motor current
V4	Motor torque	%	Calculated actual torque/nominal torque of the unit
V5	Motor power	%	Calculated actual power/nominal power of the unit
V6	Motor voltage	V	Calculated motor voltage
V7	DC-link voltage	V	Measured DC-link voltage
V8	Temperature	°C	Temperature of the heat sink
V9	Operating day counter	DD.dd	Operating days [1], not resettable
V10	Operating hours "trip counter"	HH.hh	Operating hours [2], can be reset with programmable button #3
V11	MW-hours	MWh	Total MW-hours, not resettable
V12	MW-hours, "trip counter"	MWh	MW-hours, can be reset with programmable button #4
V13	Voltage/analog input	V	Voltage of the terminal V_{in}+ (term. #2)
V14	Current/analog input	mA	Current of terminals I_{in}+ and I_{in}- (term. #4, #5)
V15	Digital input status, gr. A		
V16	Digital input status, gr. B		
V17	Digital and relay output status		
V18	Control program		Version number of the control software
V19	Unit nominal power	HP	Shows the power size of the unit
V20	Motor temperature rise	%	100%= temperature of motor has risen to nominal
V21	Reference frequency	Hz	Frequency reference
V22	Torque reference	%	Torque reference when torque control in use

1) DD = full days, dd = decimal part of a day
2) HH = full hours, hh = decimal part of an hour

Table 8-1 Monitoring items

9 SV9IOC103 Control Connections



Terminal		Signal	Description
206	+24V	Control voltage output	Voltage for switches, etc. max 50 mA
207	GND	I/O ground	Ground for reference and controls
208	CMC	Common for DIC1—DIC5	Connect to GND or +24V
209	DIC1	Digital Input C1	Programmable; Default = Not Used
210	DIC2	Digital Input C2	Programmable; Default = Run Enable Open Contact
211	DIC3	Acceleration/Deceleration time selection	Contact open = time 1 selected Contact closed = time 2 selected
212	DIC4	Jog speed selection	Contact open = no action Contact closed = jog speed
213	DIC5	Fault Reset	Contact open = no action Contact closed = fault reset
214	GND	I/O ground	
215	I_{out}+	Analog output 0-20 mA/R_L max. 500 Ω	Programmable Default = Motor current
221	TI+	Thermistor Input	
222	TI-		
223	RO3/1	Relay output 3	Programmable Default = Not used
224	RO3/2		
225	RO4/1	Relay output 4	Programmable Default = Not used
226	RO4/2		
227	RO5/1	Relay output 5	Programmable Default = Not used
228	RO5/2		

Figure 9-1 Control Connections of SV9IOC103

Note! Thermistor input terminals 221 and 222 must be shorted if not used.

Company Information

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Printed in USA
Publication No. MN04001002E/CPG
June 2004